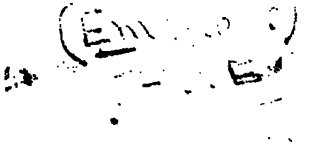

MANUAL

OF

MINERALOGY AND GEOLOGY:

DESIGNED

FOR THE USE OF SCHOOLS;

AND FOR

PERSONS ATTENDING LECTURES ON THESE SUBJECTS,
AS ALSO A CONVENIENT POCKET COMPANION
FOR TRAVELLERS,

IN THE

UNITED STATES OF AMERICA.

BY EBENEZER EMMONS, *M. D.*

ADOPTED AS A TEXT-BOOK IN THE RENSSELAER SCHOOL.

ALBANY:
PRINTED BY WEBSTERS AND SKINNERS.
1826.

NORTHERN DISTRICT OF NEW-YORK.

L.S.

BE IT REMEMBERED, That on the eighth day of June, in the fiftieth year of the independence of the United States of America, A. D. 1826, WEBSTERS & SKINNERS, of the said district, have deposited in this office the title of a book, the right whereof they claim as proprietors, in the words following, to wit:

"Manual of Mineralogy and Geology: designed for the use of schools; and for persons attending lectures on these subjects, as also a convenient Pocket Companion for travellers, in the United States of America. By Ebenezer Emmons, M. D. Adopted as a text-book in the Rensselaer School."

In conformity to the act of the Congress of the United States, entitled "An act for the encouragement of learning, by securing the copies of maps, charts and books, to the authors and proprietors of such copies, during the times therein mentioned;" and also to the act entitled "An act supplementary to an act entitled 'An act for the encouragement of learning, by securing the copies of maps, charts and books, to the authors and proprietors of such copies, during the times therein mentioned,' and extending the benefits thereof to the arts of designing, engraving, and etching historical and other prints."

RICHARD R. LANSING,
Clerk of the N. District of New-York.

PREFACE.

The first design of this Manual was to furnish the students of the RENSSELAER SCHOOL, with a text-book, which should answer in the room of the more expensive and extended treatise of Professor Cleaveland. Though this was the original design, it is hoped that students in general will find it useful in pursuing the study of minerals; and that it will prove a convenient companion for reference in the field. It is a fact, that many in our country are deterred from pursuing the study of minerals, from a want of a small, and not too expensive, work of this kind; and there are many who wish to know something in this interesting department of Natural History, but cannot afford to be at *much* expense in cultivating it. With these views, the preparation of a Manual of Mineralogy and Geology was undertaken; and the author is not without some hopes that the work will prove useful for whom it is intended. It will probably be objected to the Manual, that the descriptions are too short to answer the desired purpose. In answer, it may be remarked, that the descriptions are not intended for the solution of very doubtful cases: In those, the excellent work of Professor Cleaveland is to be consulted. V

not however believed, that the longest descriptions of minerals are the best; for after reading an extended list of characters, the mind is made up under the influence of a few of the most important.

The arrangement of the classes, and of the minerals in each class, with the exception of the metals, is different from that of any work the author has seen. It was adopted from the belief, that it is natural and convenient, and that it would not lead to error. The division of the earthy compounds into sections, it is hoped will facilitate the examinations of minerals belonging to this difficult class. It will be perceived that authorities and localities are omitted: the former, because they are not required in a book of the kind; and the latter, because in the first place, it would ill comport with the design of the work. In the second place, access can be had to the various journals where most of the original notices are given: and in the third place, experience has proved that the mention of a town or section of a country, where a particular mineral is to be found, is of but little use, unless the particular place is minutely described. The geological situation of a mineral is important, and has always been given when known.

The geological part, or the description of rocks, taken from the survey of the canal district, as *furnishes* the best account of North American

rocks which has been published. The localities of rocks, or the places where they may be examined, are given; and likewise some of the most important imbedded minerals.

In preparing this Manual the author has had constantly by him the most approved works relating to Mineralogy and Geology—as Cleaveland's Elementary Treatise on Mineralogy and Geology; Phillips' Mineralogy, 3d edition; Brooke's Introduction to the Study of Crystallography; the English edition of Mohs' System of Mineralogy, translated by Haidinger, and various periodical Journals. The author is much indebted to Professors Eaton and Beck, of the Rensselaer School, and to M. H. Webster, Esq. of the city of Albany, for the important services they have rendered him in the preparation of this work.

The most effectual and advantageous method of acquiring instruction in Natural History, particularly Mineralogy and Geology, is now offered at the Rensselaer School, in Troy. At this institution the natural sciences are taught with a strict reference to their immediate application to the business of life. If State Legislatures were to imitate the example of the liberal founder of this School, the vast resources of our widely extended country would soon be brought to view.

Chester, (Mass.) *June*, 1826.

TABULAR VIEW

OF THE

ARRANGEMENT ADOPTED IN THIS WORK.

CLASS I.

Includes those minerals not metallic which are oxidable, or which are compounds whose bases are oxidable.

This class contains four orders. The first includes the gases not acid; the second, the liquids not acid; the third, the acids; the fourth, the inflammables not gaseous.

ORDER I. *Gases not Acid.*

GENUS I. *HYDROGEN GAS.*

GENUS II. *NITROGEN GAS.*

ORDER II. *Water.*

ORDER III. *Acids.*

GENUS I.

GENUS II.

GENUS III. *SULPHUREOUS GAS.*

GENUS IV.

ORDER IV. *Inflammables not Gaseous.*

GENUS I.

CLASS II.

Includes all Minerals which are metallic, or whose bases are metallic.

CLASS II.

Includes all Minerals which are metallic, or whose bases are metallic.

CLASS II.

Includes all Minerals which are metallic, or whose bases are metallic.

CLASS III.

Includes those Minerals which consist of an alkaline or earthy base in combination with acids.

This class contains three orders—1. Alkaline salts—2. Earthy salts—3. Alkaline and Earthy salts.

ORDER I. *Alkaline Salts.*

ORDER II. *Earthy Salts.*

CLASS IV.

Includes those minerals which consist of an earth, or are compounds of earths, with variable portions of alkaline and metallic oxides.

This class is conveniently divided into sections, according to specific gravity, hardness and fusibility.

SECTION I.

Specific gravity under 2.75. Hardness superior to glass. Infusible.

SECTION. II.

Specific gravity under 2.75. Hardness superior to glass. Fusible.

SECTION III.

Specific gravity under 2.75. Hardness inferior to glass. Fusible.

SECTION IV.

Specific gravity under 2.75. Hardness inferior to glass. Infusible.

SECTION V.

Specific gravity above 2.75. Hardness inferior to glass. Fusible.

SECTION VI.

Specific gravity above 2.75. Hardness superior to glass. Infusible.

SECTION VII.

Specific gravity above 2.75. Hardness superior to glass. Fusible.

APPENDIX.

Containing Minerals of which but little is known.

INTRODUCTION

TO THE

STUDY OF MINERALOGY.

I. Definition of external Characters.

Mineralogy, in its most extensive signification, is the science of the unorganized individuals which compose the mass of the globe: in which sense it is divided into *Oryctognosy*, or knowledge of minerals by their external characters; *Chemical Mineralogy*, which teaches us to distinguish them by their elementary constituents, and *Geology*, which makes us acquainted with the relative position of the strata which compose the *crust of the earth*. Minerals may be distinguished by their external characters, which means those properties which may be discovered without the assistance of chemistry, and some immediately by the senses—as color, lustre, transparency, taste, flexibility and elasticity. In many instances the *external* characters are sufficient for the correct determination of minerals, but in difficult ones they are not sufficient, and we are obliged to resort to *chemical* characters. These two sets of characters will be considered in their order.

1st. External Characters. They are Color, Lustre, Transparency, Refraction, Form, Surface, Touch, Odor, Taste, Adhesion to the tongue, Soil, Streak, Powder, Distinct Concretions, Flexibility, Elasticity, Sound, Cohesion, Hardness, Frangibility, Structure, Fracture, Tenacity, Magnetism, Electricity, Phosphorescence, and *Specific* Gravity.

1. *Color.*

This property, which is the first we notice when a mineral is examined, is, in some instances, important; in others it is not. In general it is not so good a character for the distinction of the *earthy compounds*, as in the class of *metals*. In the former case, the color depends on a variable proportion of some metallic oxides, and is considered *accidental*; in the latter, the color depends on the nature of the mineral, and is produced by light, reflected from its essential and component parts. Of the various colors eight are assumed as fundamental. These are snow-white, ash-grey, the color of wood-ashes, velvet-black, prussian-blue, emerald-green, lemon-yellow, carmine-red, like that of vermilion, and chesnut-brown. All the colors are considered as mixtures of two or more of these, and are expressed by combining the names of the principal colors, of which the intermixture is supposed to consist, or by referring them to some well known substance whose color is nearly uniform, as *blood-red*.

When colors, or a collection of colors, appear and disappear by changing the position of the mineral, it is said to exhibit a *play of colors*, or a *chatoyement*. When rays of light are refracted, as by the prism, and exhibit the colors of the rainbow, it is said to be *irised*.

2. *Lustre.*

The lustre of a mineral depends on its disposition to reflect light more or less strongly. This character ought always to be observed on the recent fracture. It is nearly uniform both in kind and strength in minerals belonging to the same species. Lustre is of several kinds, and is described by comparing it to some well known object: thus it is *vitreous* when it

resembles broken glass; *resinous* or *waxy* when it resembles broken resin; *silky*, like that of satin; *pearly*, like that of pearl; *metallic*, when it resembles that of the metals in the pure state; (this belongs principally to opake minerals, as plumbago, galena, &c.;) *adamantine*, like that of the diamond, or some of the salts of lead. The degree of lustre is expressed by the following terms: *splendent*, when it is perceptible at a great distance, as the highly polished metals; *shining*, when it is weak at a considerable distance, but strong when the object is near the eye; *glistening* or *glimmering*, when the light is rather weak and reflected unequally, as from a number of shining points. In the absence of lustre the mineral is described as being dull.

3. *Transparency.*

When a body permits light to pass freely through, so that objects may be discerned, it is said to be *transparent*. When objects are only indistinctly perceived, it is *semi-transparent*. When light is transmitted, but objects cannot be perceived, it is *translucent*. When light passes through the edges only, *translucent at the edges*. If no light passes through any part, it is *opake*. Minerals which are nearly opake, but become transparent on being plunged in water, are *hydrophanous*.

4. *Refraction.*

When rays of light in passing through a mineral, exhibit the image of any object double, it is said to possess *double refraction*—This property is rather more curious than useful in distinguishing minerals. It may be observed in a transparent crystal of quartz, by looking through one of the faces of the pyramid and the opposite face of the prism, and holding a pin at a suitable distance between the eye and a strong light.

5. *Form.*

This is an important character in the description of minerals. Its varieties may be considered under three divisions, *regular*, *imitative* and *amorphous*. *Regular forms* are those which result from crystallization, and will be noticed under Structure. *Imitative forms* are those which resemble other bodies: they are sometimes the result of a disturbed crystallization. They are the following, viz: *cylindrical; tubular*, more or less cylindrical and hollow; *dentiform*, like a tooth; *filiform*, like a thread; *capillary*, like a hair; *dendritic* or *arborescent*, branching like a tree; *corralloidal*, resembling branches of coral; *reticulated*, like a net; *pectinated*, like a comb; *stalactical*, like an icicle; *botryoidal*, like a cluster of grapes, or it resembles large segments of small spheres; *mamillary*, resembling small segments of large spheres; *reniform*, resembling the kidney in form; *pseudomorphous*, when a mineral is made to assume the crystalline form of another by being deposited on its surface or in a cavity once occupied by another regular body. When the form of a mineral is neither regular nor imitative it is called *amorphous*.

When a mineral is scattered about in an aggregate, in masses not larger than a hazle-nut, it is said to be *disseminated*.

The term *massive* is applied to those minerals which have a crystalline structure, but not a regular form.

6. *Surface.*

The most common varieties of external surface are the following: *uneven*, presenting small irregular projections and depressions; *granulated*, when the surface is covered with roundish grains; *drusy*, when the surface is covered with minute crystals; *striated*, when the surface is marked by minute channels.

7. *Odor.*

They are the following kinds: *bituminous, sulphureous, alliaceous,* like garlic; *argillaceous,* like moistened clay; *fetid,* like sulphuretted hydrogen gas.

8. *Taste.*

This property depends on the solubility of the substance under examination, and is used principally for distinguishing the different saline bodies.

9. *Adhesion to the Tongue.*

Depends on a disposition to imbibe moisture, and usually belongs to argillaceous substances; but sometimes to minerals partly decomposed, and which have lost a portion of the water of crystallization.

10. *Soil.*

Some minerals on being rubbed on white paper leave a soil. It should be observed whether the color is similar or dissimilar to that of the mineral.

11. *Streak or Powder.*

Some minerals on being reduced to powder exhibit a change in color. It may be observed by scratching the mineral with a hard pointed body, or by pulverizing it in a mortar.

12. *Distinct Concretions.*

This may be understood by supposing a number of individuals slightly cohering in the mass, and which are easily separated without a fracture. There are several kinds of distinct concretions, as granular, lamellar, and columnar.

13. *Flexibility and Elasticity.*

These properties need no explanation.

14. *Cohesion.*

The solidity of a mineral depends upon the strength

by which its component particles cohere. When the particles are easily removed by friction or pressure, it is said to be *friable*.

15. *Hardness.*

This is one of the best characters for distinguishing minerals, though it is liable to some variation in the same species by a partial decomposition, or by the presence of some accidental ingredient. A common tempered knife is the most convenient instrument for determining the hardness of minerals.

There are several degrees of hardness to be noticed. When a mineral receives no impression from a file, it is said to be *extremely hard*, as sapphire; when a very little impression is made, it is *very hard*, as garnet; when it is very little affected by a knife, and gives fire with steel, it is *hard*, as feldspar; when it yields without much difficulty to the knife, and does not give sparks with steel, it is *semi-hard*, as fluate of lime; when it is easily cut by a knife, but receives no impression from the nail, it is *soft*, as carbonate of lime; when it is impressed by the nail, it is *very soft*, as sulphate of lime. A definite method of ascertaining the comparative hardness of minerals, is to determine in what order minerals impress or scratch each other: thus, in the series, diamond, sapphire, chrysoberyll, garnet, quartz, feldspar, phosphate of lime, carbonate of lime, and sulphate of lime, each mineral is scratched by that which precedes it. In this Manual, when glass is spoken of as a standard of comparison, *common window glass* is understood to be meant. When two minerals of nearly equal hardness are compared, it ought to be remembered that the sharp corners of a mineral will impress or scratch a smooth surface of one a little harder than itself.

16. *Frangibility.*

By this property is meant the ease with which minerals are broken, or separated into fragments. The degree of toughness or frangibility may be described in general terms, as *very tough, tough, moderately tough, brittle,* and *very brittle.* Some minerals become less easily frangible after exposure to the atmosphere.

17. *Structure.*

Structure when it exists in a mineral substance, arises from the particular arrangement of the minute portions or molecules, of which it is composed. It is always the result of crystallization. When this process is disturbed it produces an imperfect crystalline mass, without a regular external form When undisturbed, there is not only a regular internal arrangement of particles, but a regular external form.

1. STRUCTURE ARISING FROM IMPERFECT CRYSTALLIZATION—Is either *fibrous, foliated* or *laminated,* or *lamellar, slaty* or *granular.*

Fibrous. This structure presents on the fracture a surface of threads or fibres. They may be fine or coarse, broad or narrow, straight or curved, parallel or diverging, or promiscuous.

Foliated, laminated or *lamellar structure.* This structure is exhibited in minerals composed of thin plates, cohering at their broader planes. The direction of the plates may be straight, curved, undulated, or indeterminate—that is, lying in various directions.

Slaty structure. This structure is exhibited in minerals composed of rather thick plates or layers, which easily separate, but not with smooth and brilliant surfaces. When a mass exhibits layers, but does not easily separate, the mineral is rather stratified than slaty.

Granular structure. When a minersl is composed of grains either large or small, it is called granular. Sometimes the structure of each grain is foliated as the granular limestone. When the grains become invisible on account of their minuteness, it is said to be *compact*, as jasper.

2. EXTERNAL FORM. When the particles or molecules of a mineral are regularly arranged so as to produce a regular external form, it is said to be crystallized, and the science which treats of crystallization, is termed crystallography. A *crystal* may be defined a geometrical solid, bounded by plane surfaces, which are called faces or planes. An *edge* is formed by the meeting of two planes. A *solid angle* is a point formed by the meeting of three or more planes. A *prism* is rarely found having only three sides; very commonly four, six, eight, or more sides. The sides or *lateral planes* surround the *axis*, which is an imaginary line passing down the middle of the prism, from the centre of the upper *terminal plane* to the centre of the lower. The terminal planes are also called *bases*. When prisms are very long, slender and curved, they are termed *capillary*; when long and straight, *acicular*. When the prism is very short, it is *tabular*.

A *pyramid* is formed by three or more planes, which meet in a point, termed the *apex*; each plane being bounded by edges. Considered separately, the pyramid is supposed to have a *base*, which is the case in regard to the tetraedron; but in respect to most other forms, it is only imaginary, as in the octaedron, which is often termed a double four-sided pyramid. When in the room of an edge or solid angle there is a plane, it is said to be *truncated*, or *replaced* by a plane: when an edge or solid angle is replaced by two planes, it is said to be *bevelled*.

These truncations and bevelments often greatly modify the form of a crystal, so that one form often passes imperceptibly into another.

The regular external form of a mineral substance arises from the particular arrangement of the *minute portions* of which it is composed, which are termed *molecules*. This can be satisfactorily proved by mechanical division: take for example a crystal of carbonate of lime, of any form, as the six-sided prism, or the dodecaedron, and it can always be cleaved in directions parallel to the planes of an obtuse rhomboid, and always measuring 105° 5′ and 74° 55′. This is called the primary form of carbonate of lime.

The forms of crystals then are divided into two kinds, viz. primary and secondary. A primary form is that which admits of mechanical division parallel to all its planes; it is the nucleus from which all the secondary forms of the mineral species to which it belongs may be conceived to be derived, according to certain laws. The primary forms are supposed to consist of the following classes: *cube, regular tetraedron, regular octaedron, rhombic dodecaedron, octaedron* with a *square* base, *octaedron* with a *rectangular* base, *octaedron* with a *rhombic* base, *right square prism, right prism* with a *rectangular* base, *right rhombic prism, right oblique angled prism, oblique rhombic prism, doubly oblique prism, rhomboid* and *regular hexagonal prism.*

1. *Cube,* is a solid, contained in six equal and square planes.

2. *Regular tetraedron,* a solid contained within four equilateral triangular planes.

3. *Regular octaedron,* resembles two four-sided pyramids, united base to base.

4. *Rhombic dodecaedron,* is contained within twelve equal rhombic planes.

5. *Octaedron with a square base,* is contained in eight equal *isosceles* triangular planes.

6. *Octaedron with a rectangular base,* is contained within eight *isosceles* triangles, but they are not equal, the narrow planes meeting in angles more acute than the broader.

7. *Octaedron with a rhombic base,* is contained within eight equal *scalene* triangular planes.

8. *Right square prism,** differs from the cube in having its terminal edges greater than its lateral.

9. *Right prism with a rectangular base,* differs from the cube, in having three of its edges unequal.

10. *Right rhombic prism,* has a rhombic base, and its lateral planes equal. These planes may be either square or rectangular.

11. *Right oblique angled prism,* has for its base an oblique angled parallelogram, and its adjacent lateral planes are unequal, one of which must be rectangular.

12. *Oblique rhombic prism,* has a rhombic base, and for its lateral planes equal oblique-angled parallelograms. If its faces were equal rhombs it would be a rhomboid.

13. *Doubly rhombic prism,* its bases and lateral planes are all oblique angled parallelograms. Each pair of parallel planes are equal and similar.

14. *Rhomboid,* is a solid contained in six equal rhombic planes, and having two and only two of its solid angles composed of three equal plane angles: these are called the summits.

* Prisms which stand perpendicular when resting on their base, are called *right* prisms. Those which incline from the perpendicular, are called *oblique.*

15. *Regular hexagonal prism*, is a solid whose bases are regular hexagons.

The secondary forms of crystals consist of those varieties belonging to each species of a mineral, which differ from the primary form.

The secondary forms of crystals are numerous and often complicated, and at first view may appear to possess no mutual relation; but the student will eventually discover, that a substance, from whatever locality or country it may be brought, always assuming crystals which readily yield to mechanical division, will always afford by it the same *nucleus* or primary form.

Crystals are supposed to be first formed by the aggregation of a few homogeneous molecules, which arrange themselves around a single central molecule in some determinate manner, and increase in magnitude by addition of similar molecules to their surface. In these additions the molecules appear to arrange themselves so as to form plates, which successively, either partially or wholly, cover each other. When the plates only *partially* cover each other, it gives rise to what is called *decrement*, and takes place always when pyramids are formed or angles replaced.

It is evident that the regular forms, which crystals exhibit, must depend on regularity of form in the particles which compose these crystals. These particles are the same into which a body is reduced by solution, and are called integrant particles, and are the smallest into which a body can be reduced without destroying its nature. *Integrant* particles differ from *elementary*: the former may be separated without decomposition, but the latter are the result of chemical analysis. For example, if sulphuret of lead be pulverized ever so fine,

each particle remains sulphuret of lead; but if by any means the sulphur is separated from the lead, it is then reduced to its elementary particles.

There are several kinds of integrant particles. The following table exhibits the classes of integrant particles which are the most agreeable with theory and observation. It is extracted from Brookes' Introduction to Crystallography.

Cube,
Regular tetraedron,
" octaedron,
Rhombic dodecaedron,
} integrant particle a cube.

All quadrangular prisms—integrant particles similar prisms.

Octaedron with a square base—integrant particles similar prisms.
" with rectangular base—integrant particle a rectangular prism.
" " rhombic base—integrant particle a rhombic prism.
} Proportional in dimensions, to the edges of the base and axis of each particular octaedron respectively.

Rhomboid—integrant particle a similar rhomboid.

Hexagonal prism—integrant particle an equilateral triangular prism.

It has been stated that crystals increase in size merely by the application of particles to their surfaces. This may be illustrated in an easy and familiar manner, by dissolving common salt, and then evaporating the solution slowly. Crystals of salt will be deposited on the bottom and sides of the vessel. If we examine these crystals, we shall find them to consist of modified or entire cubes. Let the evaporation proceed, and they will attain considerable size. If they are now examined, we shall frequently find that both the cube and modified crystal, when enlarged, preserve their form.

If we apply a knife to the face of one of these cubes, parallel to and near its edge, a laminæ will easily

separate, leaving a brilliant polished surface; and this will take place parallel to all its faces, and it will be found to cleave in no other direction than parallel to the faces of the cube. Thus we may prove both by synthesis and analysis, that crystals increase in size by the application of homogeneous molecules to their faces.

This regular structure is supposed to belong to all crystallized bodies, and can, in a great number of instances, be proved to exist by mechanical division. Mechanical division always takes place along what are called the *natural joints*, which are often marked by lines, as in calcareous spar or selenite; and the ease and freedom with which the laminæ separate at these joints, depends on the degree of molecular attraction.

There are among minerals some which yield to mechanical division in one or two directions, but do not admit of it in a third, so as to produce a regular solid. This circumstance has introduced the terms *single*, *double*, *treble* and *fourfold cleavage*. When a mineral splits in one direction only, it is a single cleavage; when in two, double. This would produce the lateral planes of a four-sided prism. When in three, it is a triple cleavage, and produces the cube, rhomboid or any parallelopiped, whose faces are parallel, taken two and two. A fourfold cleavage, or one in four directions, will produce the octaedron, tetraedron, or perfect hexagonal prism. The rhombic dodecaedron has a six-fold cleavage, or possesses six pairs of parallel planes lying in different directions.

Mica presents us with an example of single cleavage: feldspar, cyanite, sulphate of lime, afford instances of a double cleavage. Calcareous spar, carbonate of lime, galena, of a triple cleavage; fluor spar, of a fourfold cleavage; and blende, or sulphuret of zinc, of a six-fold cleavage.

Some practice is necessary before the student will be able to cleave minerals neatly, and some experience in the choice of instruments to be used for this purpose. Fluor spar and blende yield easily to the pressure of a knife: Calcareous spar and rhomb spar to a knife, or small chissel struck with a hammer. Other minerals yield only to the cutting pincers, with straight parallel edges.

The student may obtain the primary form of fluor spar, if in the possession of a cubic crystal, by first removing all the solid angles, and then continuing the cleavage parallel to the planes thus produced. Or the octaedron, which is the primary form, may be obtained from any fragment of fluor, by observing the direction of the brilliant laminæ or planes, which indicate the natural joints, and making cleavages parallel to those planes. For the purpose of studying the relation of certain forms, as the cube, octaedron, tetraedron and rhombic dodecaedron, the crystals of fluor spar and sulphuret of zinc, afford the best examples. For the rhomboid, hexaedral prism, pentagonal dodecaedron, and dodecaedron with isosceles triangular faces, the crystals of carbonate of lime afford the best subjects.

The great diversity of secondary forms is produced by what are called the laws of decrement. These laws are four, *decrements on the edges*, *decrements on the angles*, *intermediary decrements*, and *mixed decrements*.

The two first laws are the most common. In respect to the structure of secondary forms, which result from the operation of these laws, the student will best understand them by preparing wooden models, of the following description: a cube, regular octaedron and thin plates, which are supposed to consist of certain number of cubic particles, and which shall form a decreasing

series by the abstraction of one row of cubic molecules from each plate.*

Let these plates be placed on one of the faces of the cube, commencing with the largest, and finishing the pile with a single cube; a four-sided pyramid will be formed which will illustrate the law of decrement on the edges, which takes place where ranges of particles are abstracted parallel to the edges of the nucleus. If we erect similar pyramids on all the faces of the cube, the resulting solid will be a rhombic dodecaedron. If these plates are now removed one by one, it will illustrate familiarly the relation of the cube, considered as a primary form, and the dodecaedron as secondary. If triangular pyramids, composed of plates as in the preceding instance, be placon all the faces of the octaedron, the resulting solid will be a cube.

Decrements on the angles take place when particles of molecules are removed from the angles of the laminæ. From the first plate let a cubic particle be removed from each corner or angle, from the second two, and so on until a pyramid is completed by a single cube. It is necessary that the first plates extend beyond the edges of the nucleus, which is supposed a cube, by one row of particles, to prevent the appearance of re-entering angles, so that it first increases in size. If on all the faces of the cube, plates be superimposed, the solid will be composed of 24 quadrilaterals, united three and three, in one plane: hence the secondary is an octaedron, contained under eight equilateral triangles, and the centre

* It is necessary to suppose that the minute particles of which a substance is composed, though infinitely small in reference to our senses, possess a regular geometric form. In illustrating the subject, we must also suppose them to have a perceptible size, but it is no matter what size, whether an eighth, quarter, or half an inch or more in diameter—if they are uniform, the result will be the same.

of each face will correspond to each of the solid angles of the nucleus. Sulphuret of lead furnishes instances of this form of crystal. If the process is stopped when half of the number of plates have been superimposed, the secondary form would be contained under 14 faces, six of them squares, parallel to the faces of the cube and the remaining parts of the faces of the unfinished octaedron.

For the purpose of measuring the angles at which the faces of crystals meet, the *goniometer* was invented, of which there are two kinds, the *common* and *reflecting*. For a description and explanation of the principles on which they are constructed, see Cleaveland's Mineralogy, page 22, second edition.

18. *Fracture.*

By this term it is intended to express the appearance of a surface produced by breaking a mineral in any direction, which does not coincide with a natural joint or seam. There are several kinds of fracture to be noticed. When the surface is hollowed out, as the interior of a shell, it is said to have a *conchoidal fracture.* Flint is a good example. When the surface presents numerous small elevated and sharp projections, it has a *hackly fracture.* Broken bars of iron are good examples of this kind of fracture.

19. *Magnetism.*

When metallic substances possess the property of attracting or repelling the poles of a magnet, or taking up filings of iron, they are said to be magnetic. Some mineralogists suppose that this property is peculiar to iron. It is necessary that the iron should always be in a state of low oxidation in order to exhibit the magnetic property.

20. *Electricity.*

Some minerals on being exposed to heat or pressure become electric, or capable of attracting and repelling light bodies, as fibres of silk, hair, tow, &c. It is well known that there are two states of electricity, viz. positive and negative. In order to observe the effects of the electric fluid, it is necessary that it should be first disturbed by friction, pressure or heating. A thin transparent plate of calcareous spar is an instance of the disturbance of this fluid by pressure. It is perhaps unnecessary to remark, that it must first be insulated, and then pressed between the thumb and finger, for a few moments. Black schorl when heated to a little below 212° becomes electric, and the opposite parts of the crystal present the electric fluid in different states.

21. *Phosphorescence.*

When a body shines with a feeble light, unaccompanied by heat, it is said to *phosphoresce*. Some minerals exhibit this property by rubbing them against each other; quartz is an instance. Fluor spar phosphoresces by being placed on a shovel heated nearly to redness. This property does not appear to be essential to those minerals in which it exists.

22. *Specific Gravity.*

The specific gravity of a body is its weight compared with that of another body of the same magnitude. Thus, if a cubic foot of water weigh 1000 oz. and a cubic foot of iron 7000 oz. their specific gravities are as 1 : 7. Distilled water at the temperature of 60 degrees is assumed as the standard of comparison; so that it is necessary only to express the specific gravity with one number or term. The following method may be taken for obtaining the specific gravity of a mineral heavier than water.

Weigh the mineral, attached by a fine thread of silk to one end of a delicate balance—this gives us its absolute weight. Next weigh it immersed in distilled water at 60°, and we learn the weight lost by immersion, or in other words we ascertain the weight of its bulk of water. Now divide its absolute weight by that which it lost in water, and the quotient is its specific gravity. For ascertaining the specific gravity of liquids, a thin phial is employed which holds 1000 grs. of distilled water at the temperature of 60°. If filled with any other liquid and weighed, we learn its specific gravity: thus it will be found that when filled with mercury, its weight would be 13.500 grs.; if filled with sulphuric acid, 1850 grs.; with nitric acid, 1420, which numbers express their specific gravities.

Specific gravity is one of the most important of the external characters, and never ought to be omitted in the examination of a mineral substance. There is often however a little variation owing to a partial decomposition, or to accidental ingredients. It is a property which depends on the nature of its essential constituents, and in the same species rarely varies so much as to lead to error in the designation of the species.

2d. CHEMICAL CHARACTERS. Those characters which minerals exhibit after being exposed to agents which produce an essential change in the arrangement of their particles, are called *chemical characters*. In mineralogy it is necessary that these should be few and of easy application. The most important are the action of the *blowpipe*, and action of *acids*.

1. *Action of the Blowpipe.*

The use of this instrument depends on the power of producing a constant and pretty uniform stream of air.

For this purpose the mouth is to be filled with air, which must be pressed out with the muscles of the mouth or the buccinator muscle, while the breathing is kept up through the nose. The best way, of course, of attaining a dexterous use of this instrument, will be by practice; commencing with some substance easy of fusion, and supported on charcoal, or on a few fibres of asbestus stuck on by a little moistened clay. In using this instrument we have the advantage of observing the effect of the heat. It will be observed that there are two cones of flame produced; the outer yellow, and the inner blue. The heat of the outer flame is less than the inner, and the most intense heat is at the point of the blue flame. The size of the substance to be acted on ought to be about the size of a pin's head, or not larger than a pepper corn. Various methods depending on the nature of the mineral, must be employed for supporting the fragment before the flame: for metallic oxides, a piece of compact charcoal is the best. The particular result of the action of the blowpipe is always to be noted, and the effect of each flame; likewise it is important to notice the odor which may escape during the experiment. Certain substances called *fluxes*, are sometimes added to the fragment to promote its fusion, and by their assistance many minerals otherwise infusible, may be melted. One of the fluxes most commonly employed is *borax*. The color communicated to the flux by the mineral, often greatly assists in determining its nature, and particularly in examining the metallic oxides. Thus, the oxide of *manganese* gives a purple color with borax; *cobalt*, a blue; *chrome*, a beautiful grass-green. The comparative ease with which a mineral fuses, is often a distinguishing character. Thus, the native sulphurets of lead and antimony resemble each other, and both

give off a sulphureous odor; but the former melts in the flame of a candle and is entirely volatilized by the blowpipe; the latter decrepitates and is reduced to a globule of lead. This is sufficient to show, that the blowpipe is an important instrument in ascertaining the nature of the mineral under examination, and it is almost impossible to proceed a step without it.

The greatest heat which it is supposed may be obtained by the blowpipe, is, according to Brogniart, about 150° on Wedgewood's pyrometer.

2. *Action of Acids.*

In most cases muriatic acid is the best to be employed. For observing its effect a fragment of the mineral may be pulverized and placed in a concave piece of glass, and covered with acid diluted with twice its quantity of water. It is to be noticed whether the mineral is acted upon at all, and if it be, whether it is dissolved quietly or with effervescence; and whether the effervescence is moderate or brisk, and whether the solution is complete. In some minerals, as the alkaline-earthy substances, the powder becomes gelatinous. In most cases the process is carried on at the common temperature, in others by the application of a gentle heat. Liquid ammonia may in some instances be employed as the solvent and as a test. Thus, if it is added to the solution of nitrate of copper, it becomes of a beautiful azure blue. The action of acids, and the application of tests and other chemical characters, may be greatly varied at will, and the results of these form an important feature in the character of minerals; and they become the more interesting as they are so rapidly and conveniently observed. Thus, carbonate of lime may always be detected by pouring a little diluted acid upon it, and the carbonate of lead may be distinguished at once from sulphate of barytes, by its *effervescence.*

Relative proportions of the Earths as Mineral constituents.

Silex, considered as a simple substance, is the most abundant in nature. It constitutes the chief ingredient of a large number of the most abundant rocks; it enters largely into the compositions of clays and soils, and forms more than half of those minerals which are termed simple. Silex when pure, in common with the rest of the earths, is perfectly white, and of a harsh feel: it has neither taste nor smell. Its specific gravity is 2.26.

Alumine or *Clay.* This is considered the most abundant after silex. It occurs abundantly in primitive, transition and secondary rocks. It cannot be said to have been found in a pure state, except in a few minerals, as the sapphire, which ranks in hardness next to the diamond.

Lime. This substance though very abundant, is less so than alumine. It is however the most abundant substance in secondary rocks.

Magnesia is not considered as very abundant. It is confined mostly to the serpentine and talcose rocks; likewise, in the limestone called magnesian. But whenever present, even in small quantities, it gives a characteristic property, that of a soapy feel. It is sometimes present in soils.

Barytes and *Strontian* may be considered as rare earths, and are chiefly found in mineral veins. They have not been detected in rocks or soils, and are almost always combined with acids. They possess the greatest specific gravity of any of the earths. Zircon, glucine, yttria and thorina, are extremely rare, and are only found in some of the scarce minerals.

Comparative Ages of the Earths.

Silex, alumnie and lime are considered as the oldest of

the earths, as they enter into the composition of the primitive rocks. Magnesia enters likewise into the composition of the talcose rocks, which belong to the primitive class. Zircon and glucine are found in the constituents of a few imbedded minerals, which are always associated with these rocks. Zircon is found in the oldest gneiss, and glucine forms about 14 per cent of the beryl, which is very constantly found in veins of granite traversing mica slate.

Arrangement of the Classes adopted in this Manual.

The classes are arranged so as to commence with the most simple, and proceed to the most complex; and this order appears the most natural. The first class includes the oxidable minerals not metallic, and are properly the combustibles. Next in order are the metals, which are known to be combustible at high degrees of heat. The class of salts very naturally follows the metallic class, as their bases are analogous to the metals. The class of earthy compounds being more complex and difficult than all the preceding, are placed in the 4th class.

MANUAL

OF

MINERALOGY AND GEOLOGY.

CLASS I.

Includes all Minerals not metallic which are oxidable, or which are compounds whose bases are oxidable.

ORDER I. Gasses not Acid.

GENUS I. HYDROGEN GAS.

Amorphous; transparent: odor peculiar: burns with a feeble light in atmospheric air, and if mixed with it explodes when brought in contact with an ignited body. It imparts no taste to water.—Specific gravity 0.068.

It is developed from beds of lime-stone and coal. It is twelve times lighter than atmospheric air.

SPECIES I. CARBURETTED HYDROGEN.

Amorphous; transparent: odor empyreumatic. Sp. gr. 0.570. It is composed of carbon 74.00, hydrogen 26.00.

There are two varieties of this gas, viz.

Var. 1. *Light Carburetted Hydrogen.* Burns with a blue flame. Arises from decomposed vegetables.

2. *Mixed Carburetted Hydrogen.* Burns with flame blue at the base, red above. From pit-coal.

Carburetted hydrogen is developed from stagnant pools, marshes, mines of coal, &c. It is often called fire-damp.

SPECIES II. SULPHURETTED HYDROGEN.

Amorphous and transparent : odor of putrid eggs. Sp. gr. 1.191.

It burns with a reddish blue flame, and if ignited with oxygen explodes. It is absorbed by water, and imparts a nauseous odor and taste. It is composed of hydrogen 5.824, sulphur 94.176. Abundant in certain mineral waters, as those called hepatic, or sulphuretted water.

SPECIES III. PHOSPHURETTED HYDROGEN.

Amorphous ; transparent : odor of putrid fish. Sp. gr. 0.902.

It imparts a bitter taste to water with which it has been in contact. It is the product of animal and vegetable decomposition. It is considered the ignis fatuus.

GENUS II. NITROGEN GAS.

Amorphous and transparent ; without odor or taste : incombustible. Sp. gr. 0.968.

It is found issuing in vast quantities from the sparry lime rock at Little Hosick and New-Lebanon Springs. *Eaton* and *Beck*, in Rensselaer county survey.

SPECIES I. ATMOSPHERIC GAS.

Amorphous ; transparent : without odor or taste. Sp. gr. 1.00.

It consists of oxygen 21.00, nitrogen 78.999.

ORDER II. LIQUIDS NOT ACID.

GENUS I. PURE WATER.

Transparent ; without taste or odor. Sp. gr. 1.00.

It consists of oxygen 88.94, hydrogen 11.06. Its form is changed by a high or low temperature, becoming vapor or ice. In the latter state it is crystallized in plumose stellæ.

ORDER III. Acids.

GENUS I. CARBONIC ACID.

Form gaseous; transparent: taste slightly acid: odor pungent. Sp. gr. 1.519. Differs from atmospheric air by reddening vegetable blues.

It consists of carbon 27.40, oxygen 72.60. It occurs in natural and artificial excavations.

GENUS II. MURIATIC ACID.

Form gaseous; amorphous: odor pungent and suffocating: taste strongly acid. Sp. gr. 1.278.

Muriatic acid is composed of muriatic acid 75. 31, water 24.69. It has a strong affinity for water—hence when disengaged from its combination it appears in the form of vapor. It occurs in the vicinity of volcanoes.

GENUS III. SULPHUROUS GAS.

SPECIES I. SULPHUROUS ACID GAS.

Form gaseous: odor like burning sulphur. Sp. gr. 2.247. B.

It consists of sulphur 50.144, oxygen 49.856. It is readily absorbed by water—Is gaseous at the common temperature; but by exposure to frost or pressure it becomes liquid. It is abundant near volcanoes, rushing out of the crater in considerable quantities.

SPECIES II. SULPHURIC ACID GAS.

Form liquid, being combined with water: taste strongly acid and burning. Sp. gr. 1.857..5wish,

The liquid sulphuric acid contains 1820.
of water. It occurs in the neighborhood noticed
canoes, as Ætna, and in great quantit
island of Java.
, yellowish

GENUS IV. BORACIC ACI ame, much

Form solid; crystalline: primitive odor, and

taedron : taste slightly acid at first, afterwards bitter and cooling, lastly sweetish. Sp. gr. 1. 480. B.

Boracic acid is generally in the form of loose scaly particles, of a pearly lustre, and of a greyish and yellowish white color. It is fusible in the flame of a candle, and yields a glassy globule. If pure, it consists of boron 25.83, oxygen 74.17. It is deposited from the hot springs near Sasso, and from the *lagoni* of Tuscany.

ORDER IV. INFLAMMABLES NOT GASEOUS.

GENUS I. SULPHUR.

Solid; crystaline : primitive form an elongated octaedron : inodorous : color yellow : burns with a blue flame, giving off a strong suffocating smell. Sp. gr. 2.00.

It is found in the vicinity of volcanoes.

GENUS. II. CARBON.

SPECIES I. DIAMOND.

Color white; also various shades of blue, red, yellow, green, brown, grey and black : transparent : lustre adamantine. Hardest of all substances. Sp. gr. 3.520.

The diamond is found in detached crystals or crystalline grains. The structure is perfectly lamellar, yielding readily to mechanical division, parallel to all the planes of an octaedron. The diamond is carbon in its pure state.

Diamonds are found in India in a tract of country called the Diamond Mines, extending from Bengal to Cape Comorin, at the foot of a chain of mountains 50 miles in length. They are likewise found in the interior of Brazil, in a part of country situated nearly due north of Rio Janeiro.

The diamond district is hilly and considerably elevated, and abounds in small streams. The face of the country is covered with grit stone rocks, full of rounded quartz pebbles, giving to the whole the appearance of pudding stone.

Diamonds are always obtained from the beds of streams and rivers.

SPECIES II. ANTHRACITE.

Amorphous; solid; opake: color black: burns without flame or smoke: odor none. Sp. gr. 1.4—1.8.

There are three varieties of this substance, the massive, slaty, and columnar.

Var. 1. *Massive Anthracite.* Fracture conchoidal: lustre shining metallic; often superficially tarnished; brittle: burns without flame or odor, leaving a whitish ash.

2. *Slaty Anthracite.* Structure imperfectly slaty in one direction; cross fracture flattish conchoidal. It is composed of carbon 72.05, silex 14.00, alumine 2.29, oxid of iron 3.41.

3. *Columnar Anthracite.* It occurs in the form of short small prismatic concretions, either straight or curved. Lustre metallic.

SPECIES III BITUMEN.

Liquid and solid, and of intermediate degrees of consistence: odor bituminous in the fluid varieties, when cold: color limpid, yellowish, brown, and black. Sp. gr. 0.828 to 1.20.

The following varieties of bitumen are noticed by mineralogists:

Var. 1. *Naptha.* Fluid; colorless, yellowish and transparent: burns with a blue flame, much smoke, and gives out a penetrating odor, and

leaves no residuum. It is the only known fluid in which oxygen does not exist in some proportion. It is composed of carbon 82.20, hydrogen 14.80. Sp. gr. 0.71—0.84.

It is found in Persia, near Bokee, on the western shore of the Caspian sea. The naptha here arises from a sandy marl soil, in the state of an odorous, inflammable vapor which readily takes fire at the approach of flame; forming a source of perpetual fire. It is collected in wells in a fluid state. It is employed for illuminating streets, instead of oil, in Genoa. It is used for preserving potassium, sodium, &c.

2. *Petroleum.* Semi-fluid and viscid; transparent; opake: colours black and brown of various shades; reddish and yellowish brown. It differs from naptha principally in being less fluid. It exhales a dense black smoke, leaving a small earthy residue. Sp gr. 0.87.

It is usually found in the vicinity of coal.

3. *Maltha* differs from the preceding varieties in its greater tenacity, viscidity, and solidity; it being of the consistence of pitch. It is used for the same purposes as tar. It is found in nearly the same places as petroleum, and by exposure to air it passes into asphaltum.

4. *Elastic Bitumen.* This substance has a greater resemblance to India rubber than any other known substance, being soft, flexible, and elastic; and like that substance will remove the traces of plumbago from paper, but soils the paper itself. Color brown, of different shades. It yields a bituminous odor, and burns with a bright flame. Sp. gr. 0.90—1.23.

It is found only at Castleton, Derbyshire, Eng. *in secondary* limestone.

5. *Asphaltum.* Dry, solid and brittle: fracture conchoidal: lustre shining, resinous, but sometimes earthy, or nearly dull. It has little or no odor when cold. Sp. gr. 1.60.

When pure it burns freely and leaves but little residue. It is too hard to receive an impression from the nail. Color black, brownish-black, and sometimes it has a tinge of red or grey. It is supposed the ancients used maltha and melted asphaltum as a cement in the construction of buildings, walls, &c.

Appendix to Bitumen.

1. *Retinasphaltum.* This substance presents different shades of brown, yellow and red. It varies from translucent to opake It is soft and brittle, but when taken recently from the earth is elastic and flexible. Sp. gr. 1.13.

It differs from elastic bitumen in burning at first with a fragrant odor, which at last becomes bituminous. It is composed of resin 55, asphaltum 42, earth 3.00. It is found in coal formations.

2. *Fossil Copal.* It occurs in irregular yellowish brown masses, more or less translucent. It is brittle, and yields with ease to the knife. When heated it melts and exhales a resinous aromatic odor. In the flame of a candle it burns with a clear yellowish flame. It was first found at Highgate-Hill, near London, in a bed of blue clay, also in Delaware. It resembles wood partially decomposed.

3. *Hatchetine.* Color varies from yellowish-white to wax-yellow. Its texture is something like beeswax and spermaceti: it melts in water heated to 107°. It is destitute of odor, and has the hardness of soft tallow.

It has been found in South Wales, associated with calcareous spar and quartz, in a vein traversing iron stone.

SPECIES IV. AMBER.

Amber occurs in irregular spherical masses: fracture large conchoidal: lustre resinous: color yellow, passing into brown, red, and white: transparent: translucent: yields to the knife, but sufficiently compact and hard to be turned and polished: resinous, becoming electrical by friction. Sp. gr. 1.08.

It burns with flame and smoke, and some intumescence. It exhales while burning an agreeable odor, and leaves but little residue. By distillation it yields an empyreumatic oil and succinic acid. It is composed of carbon 80.59, hydrogen 7.31, oxygen 6.73, lime, alumine and silex 3.27.

Amber is supposed to be derived from the vegetable kingdom, as it often contains insects and organic bodies. It is found in alluvial deposits.—Amber is employed in the composition of varnishes. The oil and acid are employed in medicine.

SPECIES V. COAL.

Amorphous; opake: fracture conchoidal in different degrees: color black or brown: lustre resinous, more or less distinct. Too hard to receive an impression from the nail. Easily broken, and sometimes friable. It burns with a whitish flame, yielding a black smoke and bituminous odor. Sp. gr. 1.2—1.3.

This mineral may be distinguished from anthracite by its flame, black smoke and bituminous odor. It is harder than asphaltum; not so brittle, and of greater specific gravity.

There are several varieties of coal, but all pass into each other by insensible shades.

Var. 1. *Cannel Coal.* Colour black; texture compact. Sp. gr. 1.27.

It is composed of carbon 72.2, bitumen 20.68, ashes 3.12. When on the fire it decrepitates and breaks into angular fragments.

2. *Slaty Coal.* Structure slaty; cross fracture even and conchoidal: lustre resinous: brittle. It swells and agglutinates in burning, and leaves but little residuum. Sp. gr. 1.25—1.40.

It is composed of carbon 56.8 to 73.5, bitumen 23.2 to 43. It likewise yields nitrogen, and a little oxygen and hydrogen.

3. *Coarse Coal.* Structure in the cross fracture coarse grained. It is harder and heavier than slaty coal, and burns with greater difficulty, and does not agglutinate. Sp. gr. 1.45.

4. *Sooty Coal.* Dull; soils the fingers. It is more or less friable. It burns freely with a bituminous odor, leaving a small residuum of ashes. It is associated with the slaty variety.

Coal may be considered as the most useful substance the mineral kingdom affords. Hence a knowledge of its associations is peculiarly interesting and valuable

The United States abound in this article. For a particular account of the different coal formations, localities, &c. see Cleaveland's Mineralogy, article Coal.

Appendix to Coal.

Dysodile. Color greenish or yellowish-grey Its masses are composed of thin layers, whic

may be rendered flexible and translucent, by immersion in water. Sp. gr. 1.15.

While burning it exhales an odor uncommonly fetid, and leaves a residuum equal to one third its mass.

It is found in Sicily, near Syracuse, forming a thin bed in secondary limestone.

SPECIES VI. LIGNITE.

This substance exhibits more or less the structure of wood, yet there is some diversity in the external character of the different varieties. All of them appear to have originated from wood which has been buried in the earth.

Most of the varieties burn with flame, but do not agglutinate. They differ from coal by yielding a peculiar acid liquor. Their color is usually brown and sometimes black.

Var. 1. *Jet.* Compact: fracture conchoidal: sufficiently hard and tough to be turned in a lathe and polished: color black or brownish: lustre shining and splendant. Sp. gr. 1.30.

It burns with flame, giving off an aromatic odor different from coal and bitumen.

2. *Brittle Lignite.* It may be distinguished from other combustibles by its great brittleness. Its surface is cracked, and may always be divided into cubical fragments. By exposure to air it falls to pieces. It burns with a disagreeable odor.

3. *Bituminous Wood.* It presents in the longitudinal [illegible] ture, a fibrous structure, and but little lustre. In cross fracture is flat conchoidal; exhibiting a re[illegible]nous lustre. It often exhibits the annual layers [illegible] wood.

4. *Brown Lignite.* This substance resembles bituminous wood, but is not so distinctly fibrous: color brown.

5. *Earthy Lignite.* Fracture dull, fine grained and earthy. It burns like tinder.

The above mentioned varieties are found in alluvial earths, and are sometimes connected with secondary rocks, of the coal formation.

SPECIES VII. PEAT.

This substance is essentially composed of vegetable matter in various states of decomposition, but is more or less mixed with earths and salts. When recently dug, it forms a viscid slimy mass, which by exposure to the air becomes dry, hard and more or less light and brittle. Two varieties are noticed—fibrous and compact peat.

Var. 1. *Fibrous Peat* is composed chiefly of vegetable fibres united by a slimy vegetable matter.

2. *Compact Peat.* It forms a slimy mass, sufficiently tenacious to be cut and molded into small regular solids, like brick. When dry, its texture is compact, and exhibits an earthy fracture.

CLASS II.

Includes all Oxidable Minerals which are metallic, or whose bases are metallic.

Metals are found in a metallic state, or combined with sulphur, with oxygen, or with an acid. In a metallic state, metals are either pure or combined with each other, forming alloys. Metals when combined with sulphur are called sulphu-

rets; when with oxygen, oxyds; and when with acids, salts. Metals possess a great specific gravity, and are expansible by heat, and may be volatilized.

GENUS I. GOLD.

It is found only in the metallic state, but is more or less alloyed with other metals.

SPECIES. NATIVE GOLD.

Color various shades of gold yellow: soft, inelastic, flexible, malleable and ductile. Sp. gr. 17.19. Commonly alloyed by silver, copper and iron.

Gold crystallizes in various forms. The cube is the primary form. Gold resembles the sulphuret of iron in color, but may be distinguished by its malleability.

Gold is found principally in alluvial deposits, in the form of grains. It is sometimes found in quartzose veins, traversing granite, gneiss, mica slate, &c.

Sub. Spe. *Argentiferous Native Gold.* Color varies from brass-yellow to silver-white. It contains gold 64.00, silver 36.00.

GENUS II. PLATINA.

It is found always in the metallic state, usually alloyed with other metals.

SPECIES I. NATIVE PLATINA.

Color between steel-grey and silver-white. It is but little softer than iron; infusible, malleable and ductile. Sp. gr. 15.6.

It resembles silver, but has less lustre, and is not so white.

Platina like iron may be welded. It is always found in rounded grains, in the sands of rivers, in South America.

GENUS III. OSMIUM.

Little is known of this metal in its pure state. It is found alloyed with iridium in small irregular grains, which have a paler color than platina, and are harder and heavier. The structure is lamellar. Sp. gr. of the alloy, 19.5.

GENUS IV. RHODIUM.

Color greyish-white : infusible : not malleable. Sp. gr. above 11.00. It communicates a rose color to dilute solutions of salts which contain it.

GENUS V. IRIDIUM.

Color of platina : not malleable : brittle : structure foliated. Sp. gr. 19.5.

GENUS VI. PALLADIUM.

Color of platina, but differs in being fused with comparative ease. Sp. gr. 11.8—12.15. Malleable and very ductile.

The four last described metals are found alloyed with platina, and with each other. They are exceeding scarce.

GENUS VII. SILVER.

Color nearly white : lustre superior to gold, but inferior in malleability. It is very ductile, and easily cut with a knife. Sp. gr. 10.47.

SPECIES I. NATIVE SILVER.

Native silver differs from pure silver in being

less malleable and ductile. It is likewise harder. Sp. gr. 10.5.

It occurs in small grains, massive and crystallized. The cube is assumed as the primitive form. Native silver is usually alloyed with other metals, as copper, antimony, &c. which affects the specific gravity.

It occurs in primitive, transition and secondary rocks.

Sub. Spe. *Auriferous Native Silver.* Color yellowish-white. Specific gravity greater than pure silver. It is composed of silver 72, gold 28.

It crystallizes in cubes : occurs in veins in primitive rocks.

SPECIES II. ANTIMONIAL SILVER.

Color nearly silver-white, but the surface has a tinge of yellow or red. Structure foliated : yields to the knife ; brittle. Sp. gr. 9.44—10.00.

Antimonial silver is reduced before the blowpipe, the antimony being driven off in white fumes, possessing a peculiar odor.

It occurs in veins in granite, greywacke and clay slate, associated with the ores of lead, silver, arsenic, zinc, &c. It is composed of silver 84, antimony 16.

Sub. Spe. 1. *Arsenical Antimonial Silver.*— Color of native silver, but is commonly tarnished of a blackish color. Harder than antimonial silver. It is composed of silver 12.75, arsenic 35, iron 44.25, antimony 4.

2. *Arsenical Silver.* Color steel-grey : lustre metallic : yields to the knife with ease : structure indistinctly foliated. When exposed to the flame of the blowpipe, it exhales the odor of garlic. *Sp. gr.* 4.4.

SPECIES III. SULPHURET OF SILVER.

Color dark steel-grey ; yields easily to the knife, and becomes detached in slivers which are flexible : streak shining metallic. Sp. gr. 7.00.

It occurs in the form of the cube, yielding to mechanical division parallel to all its planes. It is composed of silver 85, sulphur 18.

It resembles the sulphuret of lead, but may be distinguished by its malleability, and by its reduction before the blowpipe. It occurs in veins in primitive mountains, with other ores of silver, lead, and with native gold.

Sub. Spe. *Black Sulphuret of Silver.* Color dark lead-grey : fracture dull and earthy : streak feebly shining. Before the blowpipe it is readily converted into a dark slaggy mass, containing an impure globule of silver. It is associated with the common sulphuret of silver, and is probably produced by a partial decomposition.

SPECIES IV. CUPREOUS SELENIURET OF SILVER.

Color shining lead-grey : texture granular : streak exhibits the lustre of silver. It melts before the blowpipe, exhibiting the odor of horse-raddish, and leaves a small grey metallic globule. It consists of silver 38.93, selenium 26, copper 23.05. It has been found only in a copper mine in Sweden.

SPECIES V. SULPHURETTED ANTIMONIAL SILVER.

Color brick-red or crimson-red, and some varieties aurora-red : streak red with some lustre. Before the blowpipe it gives off copious white vapors, accompanied with a slight sulphurous smell. It is apparently reduced to a small bead of silver. Sp. gr. 5.5.

This rare mineral occurs in small crystals, whose primary form is an obtuse rhomboid. It consists of silver 5.60, antimony 19.

It resembles cinnabar, but is less heavy, and cinnabar is totally volatilized by heat. It is associated with other ores of silver, with lead, zinc and antimony.

Sub. Spe. 1. *Brittle Sulphuret of Silver.* Color dark lead-grey: soft, and very brittle: lustre metallic: structure lamellar: fracture conchoidal. Sp. gr. 7.

It consists of silver 66.50, antimony 10, and sulphur 12. It occurs in veins traversing primitive rocks, and is associated with most of the ores of silver.

2. *Sulphuret of Silver and Copper.* Color deep-grey: lustre shining and metallic: surface produced by fracture very brilliant: granular and partially conchoidal: brittle: melts easily before the blowpipe. Sp. gr. 6.25.

It is composed of sulphuret of silver 60.65, sulphuret of copper 38.65.

3. *Flexible Sulphuret of Silver.* Externally of a dark color, approaching to black: occurs massive and in small tabular crystals, whose primary form is a right oblique angled prism. The crystals, though minute, are extremely flexible, and yield readily to the knife.

SPECIES VI. MOLYBDIC SILVER.

Color light steel-grey, passing into tin-white. It occurs in crystals, having the form of six-sided prisms, which may be separated into thin laminæ, parallel to the terminal planes. Soft and elastic: powder iron-black. Before the blowpipe it melts

on the first impression of the flame into small globules, somewhat tarnished. Sp. gr. 7.82.

SPECIES VII. WHITE SILVER.

Color light-grey, which occasionally inclines to black: soft, sectile, and brittle: fracture fine grained. Before the blowpipe, with borax, the mass becomes amber-yellow, and the metal is reduced of a tin-white color. It is composed of silver 15, bismuth 27, lead 33, sulphur 16, iron 4.

SPECIES VIII CARBONATE OF SILVER.

Color greyish black; amorphous: fracture uneven; lustre metallic: effervesces in acids. Before the blowpipe, it is easily reduced. It consists of silver 72.5, carbonic acid 12.0. It accompanies the other ores of silver.

SPECIES IX. MURIATE OF SILVER.

Color grey, with a tinge of yellow, red or green; translucent. It has the softness of wax. In thin pieces it is flexible and malleable: crystallizes in cubes. Before the blowpipe it exhales the odor of muriatic acid, and becomes reduced. Sp. gr. 4.6—4. It is composed of silver 76.0, muriatic acid 16.4, oxygen 7.

Sub. Spe. *Argillaceous Muriate of Silver.*—Color white or pale-green: fracture earthy. Before the blowpipe it agglutinates and small globules flow out. It contains silver 24 64, muriatic acid 8.28, allumine 67.08. Muriate of silver is rare. It is found along with the other ores of silver.

GENUS VIII. MERCURY.

Mercury is fluid at the common temperature, but becomes solid at 40° below zero of Fahr. and

is then malleable, flexible, and capable of crystallizing.

SPECIES I. NATIVE MERCURY.

Color silver-white : lustre metallic : fluid : opake. It is usually seen in fine globules flowing out from masses of cinnabar.

SPECIES II. ARGENTAL MERCURY.

Color white or yellowish-white. Before the blowpipe the mercury is volatilized, leaving a globule of silver. It is a native amalgam, and is more or less solid or brittle, according to the quantity of silver. Crystallizes in regular octaedrons. It consists of mercury 64, silver 36.

SPECIES III. SULPHURET OF MERCURY.

Color some shade of red, varying from carmine to cochineal red : streak bright-scarlet : lustre dull or glimmering : structure compact, slaty and sometimes granular. Before the blowpipe it melts and is volatilized with a blue flame and sulphurous odor. Sp. gr. 6.7—8.2.

It occurs massive and crystallized. The primary form is an acute rhomboid of 108° 12′ and 71° 48′.

Var. 1. *Hepatic Cinnabar.* Color very dark-red, sometimes nearly iron-grey : structure compact and slaty : opake : brittle and sectile. Sp. gr. 7.1. It consists of mercury 81.8, sulphur 13. 7, water and loss 7.30.

2. *Bituminous Cinnabar.* It consists of cinnabar intermixed with bituminous shale, or coarse coal.

Sulphuret of mercury is found in the sandstone *and slate clay* of the coal formations.

SPECIES IV. MURIATE OF MERCURY.

Color greyish-white, grey, yellowish and greenish-grey: lustre adamantine and vitreous. It occurs crystallized in quadrangular prisms, sometimes in crusts, though rarely massive. It is wholly volatilized by heat. It is soluble in water, and lime water precipitates it of an orange color. It consists of oxyd of mercury 76.10, muriatic acid 16.4, sulphuric acid 7.6.

It is found with most of the preceding varieties.

GENUS IX. COPPER.

Copper is found in its native state: its ores are numerous and interesting.

SPECIES I. NATIVE COPPER.

Native copper possesses the characters of pure copper: surface often tarnished: crystallizes in the form of cubes, octaedrons, &c.

It is found in primitive, transition and secondary rocks.

SPECIES II. SULPHURET OF COPPER.

Color steel-grey: may be cut with a knife, and is easily fused and reduced to a grey metallic globule: often magnetic. It occurs massive and crystallized. The primary form may be considered an acute rhomboid of about 71° 30′ and 108° 30′. Sp. gr. 4.8—5.4. It is composed of copper 76.50, sulphur 22.0, iron 0.50.

This mineral resembles grey copper, but is less hard. By a partial decomposition, it passes into the var. called black copper.

SPECIES III. PYRITOUS COPPER.

Color brass-yellow : surface often tarnished : brittle : yields to the knife : lustre metallic. Before the blowpipe it decrepitates and melts, but is scarcely reduced, but with borax we obtain metallic copper. Sp. gr. 4.3.

This mineral is frequently crystallized, and the general form of the crystal is a tetraedron, but it is owing to the remarkable enlargement of the alternate planes of the primary octaedron.

Copper pyrites greatly resemble iron pyrites, both in color and lustre ; but is easily distinguished by its softness. It is composed of copper 30. 00. iron 32.20, sulphur 35.16. It occurs both in primitive and secondary rocks. By decomposition it passes into variegated pyritous copper.

SPECIES IV. GREY COPPER.

Color steel-grey or iron-black : lustre metallic. Before the blowpipe it melts into a greyish metallic globule, but is not reduced : brittle. Sp. gr. 4.5. It occurs massive and crystallized. Primary form a tetraedron.

It resembles the fine granular sulphuret of lead, but is easily distinguished by the blowpipe. It occurs in primitive and secondary rocks, associated with iron and other ores of copper.

Sub. Spe. 1. *Arsenical Grey Copper.* It differs but little in its external characters from grey copper ; but before the blowpipe it exhales the odor of garlic. It is composed of copper 19, sulphur 14.1, iron 51, arsenic 15.7.

2. *Antimonial Grey Copper.* Color dark lead-grey, approaching iron-black. Not very brittle. Composed of copper 25, sulphur 11,

antimony 34. Crystallizes in modified tetraedrons.

3. *Platiniferous Grey Copper.* Resembles grey copper in its external characters. It consists of copper, lead, antimony, iron, silver and platina; the latter varies in quantity, but does not exceed 10 per cent. Rare.

4. *Tenantite.* Resembles grey copper, but is harder. It differs from granular galena in its structure, which is lamellar, parallel to the faces of an octaedron; and likewise it exhales the odor of garlic while burning: powder reddish-grey. It is composed of copper 45.32, sulphur 28.74, arsenic 11.84, iron 9.26, silex 5. Grey copper and its varieties occur in primitive and transition rocks, as granite, clay-slate, &c. along with other ores of copper, sparry iron, &c.

SPECIES V. SELENIURET OF COPPER.

Occurs massive and dendritic: soft and malleable. It resembles native silver. Sometimes disseminated in serpentine.

SPECIES VI. RED OXIDE OF COPPER.

Color red, of various shades: crystals carmine or crimson red: streak bright red: easily broken and scraped with a knife: on charcoal it is easily reduced. It effervesces in nitric acid, and its solution assumes a green color. Sp. gr. 4.0—4.6.

It crystallizes in cubes and octaedrons; the latter is the primary form, measuring 109° 28′. Red oxide of copper resembles sulphuret of mercury, but the latter is totally volatilized by heat. It is composed of copper 88, oxygen 11.5. It occurs fibrous and compact; the former consisting

of slender transparent prisms; the latter, in compact masses, mixed with native copper.

Var. Ferruginous Red Oxyd of Copper. Color reddish-brown. It resembles the red oxide, but does not fuse, but blackens before the blowpipe. Consists of red oxide of copper and iron.

SPECIES VII. BLACK COPPER.

Color bluish or brownish-black, or black. It occurs disseminated in, or investing the other ores of copper. Friable: soils the fingers, and is heavy: infusible: with borax it yields a greenish slag. It results probably from the decomposition of the red oxide and sulphurets of copper.

SPECIES VIII. CARBONATE OF COPPER.

Of this species there are two varieties, the blue and the green carbonates.

Sub. Spe. 1. *Blue Carbonate of Copper.* Color azure-blue: streak light-blue: translucent: dissolves with effervescence in nitric acid. Before the blowpipe it becomes black, and communicates a fine green to borax. Sp. gr. 3.23—3.70.

This mineral occurs in crystals, aggregated in groups and clusters. It is sometimes in friable and earthy masses. It is composed of copper 68. 5, carbonic acid 25, water 6.

2. *Green Carbonate of Copper.* Color emerald, grass or leek-green: soft and sometimes fri-
cope: effervesces in nitric acid. It blackens be-
odor the blowpipe, and is finally reduced; with
phur it is reduced with ease, coloring the flux

2. *Ant.*
lead-grey, e two varieties of this mineral, the fi-
brittle. Co compact malachite. The fibrous is

composed of minute radiating fibres; the compact, of undulating layers, parallel to each other. Carbonate of copper is found in the oldest as well as the most recent rocks.

Appendix to Carbonate of Copper.

Copper Green. Under the name of copper green, are described certain impure ores of copper, which present great diversity of aspect and composition. Color, various shades of green and brown: fracture earthy, conchoidal: lustre shining, dull: hardness varies from friable to common quartz. With borax it fuses into a glass, presenting the common effects of copper. Some portions of a specimen resemble at one end a decomposed feldspar; at the other, hornstone. It consists of copper 40, oxygen 10, carbonic acid 7, silex 26, water 17.

Species IX. Anhydrous Carbonate of Copper.

Color blackish-brown. It appears variegated with green and red, arising from an intermixture of malachite and oxide of iron. Sp. gr. 2.62. It dissolves with effervescence in acids, and deposits a red powder. It contains peroxide of copper 60, carbonic acid 16.70, peroxide of iron 19.5, silex 2.1.

Species X. Dioptase.

Color emerald-green: translucent: hardness little inferior to glass: crystallizes in six-sided prisms, terminated by three-sided pyramids; it may be called an elongated rhombic dodecahedron: yields to mechanical division parallel to the various right planes of a rhomboid, measuring 126° 15′: lustre 43′. It is composed of oxide of copper 40, carbonic acid 32, silex 28. Sp. gr. 3.27. It first boils and

SPECIES XI. MURIATE OF COPPER.

Color emerald-green, verdigris, or blackish-green : translucent—opake. It tinges the flame of the blowpipe a bright green, and blue ; muriatic acid arises in vapor, and a bead of copper remains on the charcoal. It is composed of oxide of copper 76.6, muriatic acid 10.6, water 12.8.

SPECIES XII. SULPHATE OF COPPER.

Color rich sky-blue : taste styptic. It consists of oxide of copper 32, sulphuric acid 33, water 36. Rare.

SPECIES XIII. PHOSPHATE OF COPPER.

Color observed on its recent fracture emerald-green. On the first impression of heat it fuses into a brownish globule, which by further action of the blowpipe extends on the charcoal, and acquires a reddish-grey metallic lustre : in the centre is a metallic globule of copper. Sp. gr. 3.5. It is composed of oxide of copper 68.13, phosphoric acid 30.95. Primary form, a right rhombic prism of 110° and 70°.

SPECIES XIV. HYDROUS PHOSPHATE OF COPPER.

It occurs massive and crystallized. Color of the massive emerald-green : color of the crystallized, blackish-green or black. Primary form is said to be an oblique rhombic prism. Sp. gr. 4. 2. Before the blowpipe it melts readily into a reddish slag; on the addition of carbonate of soda, odour produced to a metallic globule. It consists of phur of copper 62.487, phosphoric acid 21.68,

2. *Ant* 5. It is found associated with native lead-grey, brittle. Co

SPECIES XV. ARSENIATE OF COPPER.

There are several varieties of arseniate of copper, which differ in their chemical characters, but may be distinguished by their external forms.

Var. 1. *Octaedral Arseniate.* Color bluish-white, sky-blue, and smalt-blue: yields to mechanical division parallel to all the planes of an obtuse rectangular octaedron: lustre vitreous: it is scratched by fluor spar. It is converted by the blowpipe into a brown friable scoria, but by subsequent fusion with borax, yields a metallic globule of copper. It consists of oxide of copper 49, arsenic acid 14, water 35.

2. *Rhomboidal Arseniate.* Color pure green: yields to cleavage parallel to the planes of the rhomboid of 110° 30′ and 69° 30′. Before the blowpipe it decrepitates, and passes into the state of a black spongy scoria; after which it melts into a black globule of a vitreous lustre: by the addition of borax it is reduced. Sp. gr. 2.5. It consists of oxide of copper 58, arsenic acid 21, water 21.

3. *Oblique Prismatic Arseniate.* Color bluish-black, passing into deep black: lustre shining: primary form of its crystals oblique rhombic prisms: somewhat harder than calc. spar. Sp. gr. 4.2. Before the blowpipe it flows like water, and in cooling crystallizes in small rhombic plates of a brown color.

4. *Right Prismatic Arseniate.* Color various shades of yellowish-green: primary form right rhombic prisms of 110° 50′ and 69° 10′: lustre vitreous or resinous: harder than fluor spar. Sp. gr. 4.2. Before the blowpipe it first boils and

then gives a hard reddish-brown scoria. It consists of oxide of copper 60, arsenic acid 39.7.

Sub. Spe. *Ferruginous Arseniate of Copper.* Color pale-blue, or light brownish-yellow, with a shade of green. Sp. gr. 4.40. Translucent—transparent. It contains oxide of copper 22.5, oxide of iron 27.5, arsenic acid 33.5, water 12.0, silex 3.

GENUS X. IRON.

The ores of iron are numerous and important, but only a few of them have been analyzed.

SPECIES I. NATIVE IRON.

Color light steel-grey. It resembles wrought iron, but is of a lighter color, more malleable and not so liable to rust. It is composed of iron 96.5, nickel 3.5.

The two following substances are ranked with native iron.

Native Volcanic Iron. It has been observed in lava and scoria of Mt. Graveneire.

Native Meteoric Iron. Lustre metallic: flexible, but not elastic: malleable and very tough. Sp. gr. 6.48—7.40.

SPECIES II. ARSENICAL IRON.

Color between tin and silver-white, but often tarnished externally with shades of yellow: lustre shining metallic.

It occurs massive, acicular and crystallized in the form of a right rhombic prism of 111° 12′ and 68° 48′. This is the primary form. Sp. gr. 5.6—6.56.

This mineral has some resemblance when crystallized to iron pyrites, but the presence of arsenic can be perceived by friction with a hard body. It is composed of iron 45.40, arsenic 54.55. This species is found in primitive rocks.

Sub. Spe. *Argentiferous Arsenical Iron.* It agrees with arsenical iron in most of its characters, but is white, and contains from 1 to 15 per cent of silver.

SPECIES III. SULPHURET OF IRON (*PYRITES.*)

Color brass-yellow, passing into grey or brown. Nearly as hard as quartz. Before the blowpipe it exhales the odor of sulphur and melts into a globule, which is obedient to the magnet. Sp. gr. 4.6—4.8.

It occurs massive and crystallized. Primary form a cube. It is composed of iron 47.30, sulphur 52.15.

Sulphuret of iron occurs in globular, stalactical, cylindrical and reniform concretions, and is found in all classes of rocks.

Var. 1. *Hepatic Sulphuret of Iron.* Color externally liver-brown ; internally steel-grey, with a metallic lustre. This variety is used in the manufacture of sulphate of iron.

2. *Auriferous Iron Pyrites.* Color deep-yellow : occurs in grains and cubes, which are deeply striated. The gold exists in a state of simple mixture.

3. *Cockscomb Pyrites.* Occurs in flattened octaedrons, presenting indented edges.

4. *Arsenical Iron Pyrites.* When struck with a hammer and also before the blowpipe, it yields arsenical as well as sulphurous vapors.

5. *Seleniferous Iron Pyrites.* Color pale-yellow. It occurs in granular masses, of which the crystalline grains possess but slight cohesion.

6. *Pseudomorphous Iron Pyrites.* It occurs filling up cavities in wood, or the interior of fossil shells, as ammonites, &c.

SPECIES IV. WHITE IRON PYRITES.

Color tin-white. Occurs stalactical botryoidal, and reniform and in crystals, which are modified rhombic prisms. It is composed of iron 45.56, sulphur 54.34.

Sub. Spe. *Magnetic Iron Pyrites.* Color yellowish, reddish or brownish. It usually occurs massive. It affects the magnetic needle. It contains iron 63.5, sulphur 36.5.

SPECIES V. MAGNETIC OXYD OF IRON.

Color iron-black, with a shining metallic lustre. Before the blowpipe it becomes brown but does not melt. Sp. gr. 4.4.

It occurs earthy, compact, lamelliform and crystallized in the regular octaedron. It is highly magnetic with polarity. It consists of protoxide of iron 28.14, peroxide of iron 71.86. It is commonly found in primitive rocks, particularly in hornblende and primitive serpentine.

Var. 1. *Iron Sand.* Occurs in small octaedrons or fragments of crystals, constituting a sand. It is strongly magnetic. It contains oxide of iron 85.5, titanium 14.0. It is sometimes chromiferous.

2. *Earthy Magnetic Oxide of Iron.* Occurs in opake bluish-black masses, soft and almost friable. Sp. gr. 2.2.

SPECIES VI. SPECULAR OXIDE OF IRON.

Color steel-grey, passing into iron-black: surface often tarnished like tempered steel: streak and powder cherry-red: scratches glass: infusible. Sp. gr. 5.

When massive it resembles magnetic oxide of iron, but it is scarcely magnetic. When crystallized its structure is foliated parallel to the faces of the primitive form, which is a rhomboid, slightly acute; its angles 93° and 87°. The faces or planes of the crystals are brilliant, and possess the lustre of polished steel. It is composed of iron 69, oxygen 31.

It occurs in primitive and secondary rocks, both in beds and veins.

Var. 1. *Micaceous Oxide of Iron.* It occurs in slaty masses, composed of minute shining scales, slightly cohering. Sp. gr. 3 to 5.07. It resembles plumbago, but is readily distinguished by its greater specific gravity. It yields about 70 per cent of iron.

SPECIES VII. RED OXIDE OF IRON.

Color red, more or less inclined to brown or grey: streak and powder mostly blood-red: opake. It is never crystallized, but often assumes some imitative form. It is nearly destitute of magnetism. Before the blowpipe, on charcoal, it becomes magnetic, and of a darker color, but does not melt. It resembles massive garnet in color.

The scaly red oxide of iron and brown hematite, are varieties of the red oxide of iron. This mineral is found in compact and fibrous masses; likewise in stalactical mammillary and botryoidal

concretions. It is almost pure oxide of iron, yielding oxide of iron 94, water 2, silex 2. Occurs chiefly in primitive mountains.

Var. 1. *Ochrery Red Oxide of Iron.* Color blood-red : friable and earthy. Usually appears on the surface of other ores of iron. Furnishes good iron.

SPECIES VIII. BROWN OXIDE OF IRON.

Color brown, usually deep, sometimes blackish-brown. It resembles the red oxide of iron, but its powder is brown or brownish-yellow, and is less fine and hard : infusible. Sp. gr. 3.40—4. 02. It presents the same imitative forms as the preceding.

Var. 1. *Brown Hematite.* Color clove-brown : surface sometimes covered with a beautiful glossy varnish : structure always fibrous. It is composed of oxide of iron 80.5, water 15.5, manganese 2, silex 2. It occurs in beds and veins, in primitive and transition rocks. It yields from 40 to 60 per cent of iron.

SPECIES IX. ARGILLACEOUS OXIDE OF IRON.

The varieties of this species are very numerous, so that it is impossible to generalize characters which will be useful. This oxide of iron is in combination with clay mostly. They are composed of oxide of iron about 64, alumine 23, water 5, silex 7.

Var. 1. *Granular Argillaceous Oxide of Iron.* Color yellowish-brown : occurs in flattened spherical masses or grains, composed of thin concentric layers : external layers compact and of a resinous lustre ; but the centre of the grain is earthy

and friable. Sp. gr. 3.14—3.40. It is composed of oxide of iron 71.5, water 14.5, silex 7, alumine 3.0.

2. *Lenticular Oxide of Iron.* It differs but little from the preceding, but the concretions are more flattened, and have no cavity: occurs in transition rocks. It yields 30 per cent of iron.

3. *Nodular Argillaceous Oxide of Iron.* Occurs in masses, composed of reniform or spherical concretions, with concentric layers enclosing a moveable nucleus, differing from the exterior in color, density and fracture. It is the Eagle Stone of the ancients.

4. *Common Argillaceous Oxide of Iron.* Color grey-brown, yellowish-brown: it becomes darker by exposure to the air: its fracture dull and earthy: soft: when moistened it yields an argillaceous odor: structure compact. Before the blowpipe it blackens but does not melt. It is composed of oxide of iron 39, water 9, alumine 40, magnesia 6. It sometimes resembles compact limestone or indurated clay, but its specific gravity is greater.

5. *Jaspery Argillaceous Oxide of Iron.* It resembles jasper, but is softer. Sp. gr. 3.19.

6. *Bog Ore.* Color brown, yellowish-brown, or blackish-brown. It has a slaggy appearance; sometimes earthy and friable. Abundant in alluvial deposits and marshy ground.

SPECIES X. PITCHY IRON ORE.

Color blackish-brown or greyish-black: lustre shining: fracture flat, conchoidal, and fine grained: translucent: yields to the knife: streak lem-

on-yellow: occurs in small masses. Sp. gr. 2.4. It consists of oxide of iron 67, water 25, sulphuric acid 8. Melts in the flame of the candle and becomes magnetic.

SPECIES XI. VITREOUS BLACK OXIDE OF IRON.

Powder is yellow: slightly scratches glass. In the flame of the candle it does not melt, but becomes magnetic.

SPECIES XII. STILPNOSIDERITE.

Color nearly black: powder brown: fracture conchoidal, with a resinous lustre: masses often composed of lamellar concretions.

SPECIES XIII. BLUE IRON STONE.

Color indigo, or lavender-blue. It occurs in opake masses, which yield to the knife, and have a dull uneven fracture. It contains oxide of iron 40, water 3, silex 50, soda 6, lime 1.5.

SPECIES XIV. PYROSMATITE (*MURIATE OF IRON.*)

Color liver-brown or pistachio-green. It is said to occur in six-sided tables or prisms: lustre shining and pearly: translucent: somewhat hard and brittle. Sp. gr. 3.08.

It consists of protoxide of iron 21.81, protoxide of manganese 21.14, sub muriate of iron 14.14, silex 35, lime 1.21, water 5. It is associated with magnetic iron and calc. spar.

SPECIES XV. HEDENBERGITE.

Color greenish-black: phosphoresces by heat and friction: scratches carbonate but not fluate of lime. Sp. gr. 3.1.

It consists of silex 40.6, oxide of iron 35, water 16, lime 3.

SPECIES XVI. CARBONATE OF IRON. (*SPARRY IRON.*)

Colors vary from greyish-white or yellowish-grey, to pale yellow, yellowish-brown, reddish-brown and even brownish-black : structure and fracture always foliated : folia straight or curved : lustre pearly, sometimes only feeble. It yields to mechanical division parallel to the faces of an obtuse rhomboid of 107° and 73°. In nitric acid it becomes brown and slowly dissolves with effervescence. Sp. gr. 3.64—4.00.

It is composed of oxide of iron 66, carbonic acid 34. It is a valuable ore of iron, as it is readily converted into steel. It resembles in structure, and often in color, calcareous spar.

SPECIES XVII. SULPHATE OF IRON (*COPPERAS.*)

This salt is easily distinguished by its peculiar astringent taste. It occurs in efflorescences or crusts.

SPECIES XVIII. PHOSPHATE OF IRON.

Color deep or pale indigo-blue ; sometimes it presents a shade of green. It has the hardness of calc. spar : flexible or brittle. Before the blowpipe it reddens, intumesces and readily melts into a steel colored globule, with a metallic lustre. Sp. gr. 2.69.

It consists of oxide of iron 41.25, phosphoric acid 19.25, water 31.25 It is found associated with bog-iron ore in N. J. It occurs massive and crystallized.

SPECIES XIX. CHROMATE OF IRON.

Color steel-grey or nearly black : fracture uneven : lustre feebly metallic : scratches glass : opake. With borax before the blowpipe it fuses

into a lively emerald-green glass. Sp. gr. 4.0—4.50

It consists of oxide of iron 34.7, chromic acid 43, alumine 20, silex 2. It occurs crystallized, granular and amorphous: primary form a regular octaedron. It is usually found in serpentine.

SPECIES XX. ARSENIATE OF IRON.

Color olive-green of different shades: scratches calc. spar: translucent. It melts in the flame of a candle, and before the blowpipe, with ebullition, exhaling the odor of garlic. Sp. gr. 4.03.

It is composed of oxide of iron 48, arsenic acid 18, water 32. It is associated with the ores of copper and iron.

SPECIES XXI. OXALATE OF IRON (*HUMBOLDTINE.*)

Color bright-yellow: yields to the nail. It decomposes on hot coals, giving out a vegetable odor, passing from yellow to black, and finally to red. It occurs in flattish crystalline masses.

It is composed of protoxide of iron 53.56, oxalic acid 46.14. It is associated with lignite.

GENUS XI. LEAD.

There are only a few well authenticated instances of lead having been found in a native state. Its combinations with the acids are numerous.

SPECIES I. SULPHURET OF LEAD (*GALENA.*)

Color, externally, of a lead-grey; sometimes blackish: structure foliated, granular or compact, and sometimes striated or fibrous; soft, sectile and brittle. Before the blowpipe it decrepitates, then melts, emitting a sulphurous odor, and a globule of lead remains. Sp. gr. 7.58.

It crystallizes in the form of a cube, which is the primary form ; and is sometimes modified by truncations. It consists of lead 85.13, sulphur 13.02. It is found in primitive, transition and secondary rocks, associated with fluor, blende, quartz, sulphate of barytes, &c.

Sub. Spe. 1. *Antimonial Sulpht. of Lead.* It has the characters of galena, but is of a darker lead-grey, and its crystals are elongated cubes. Sp. gr. 5.8.

2. *Argento-Antimonial Sulpht. of Lead.* Color light lead-grey or blackish. It melts, exhaling fumes, and leaves an impure globule of silver, surrounded by a yellow powder. Sp. gr. 5.3—5.6.

3. *Argento-Bismuthal Sulpht. of Lead.* Color light lead-grey. Before the blowpipe on charcoal, small globules of bismuth flow from it, and communicate to borax an amber yellow, with reddish spots.

4. *Arsenical Sulpht. of Lead.* Color metallic-grey : brittle : structure foliated in one direction : powder red. When heated in a tube, a red sublimate appears, which becomes yellow on cooling.

5. *Cobaltic Sulpht. of Lead.* Color shining lead-grey. Before the blowpipe it splits and gives to borax a smalt blue color.

6. *Super Sulpht. of Lead.* Color bluish-grey : earthy : takes fire and burns in the flame of a candle.

SPECIES II. TRIPLE SULPHURET OF LEAD (*BOURNONITE.*)

Color approaching steel-grey. Before the blowpipe it splits, then melts, emitting a white sulphur-

ous vapor, there remains a crust of sulphuret of lead enclosing a globule of copper. Sp. gr. 5.7.

It is composed of sulphuret of lead 47.41, sulphuret of antimony 34.23, sulphuret of copper 16. Crystallizes in rectangular prisms.

SPECIES III. OXIDE OF LEAD.

Color lively scarlet-red ; when gently heated becomes darker, and by a stronger heat on charcoal it is reduced.

Sub. Spe. *Aluminous Oxide of Lead.* Color yellow. Its other external characters resemble gum-arabic : Infusible *per se ;* but with borax melts into a transparent glass, and is reduced by the addition of nitre. It contains oxide of lead 40.14, alumine 37.0, water 19.9.

SPECIES IV. CARBONATE OF LEAD.

Color white, yellowish and greyish-white : transparent—opake : lustre adamantine. Before the blowpipe it strongly decrepitates, but is easily reduced on charcoal. Effervesces in nitric acid. Sp. gr. 6.0—7.2.

It occurs in several forms, which have received descriptive names ; as, acicular, columnar and earthy carbonate of lead. Carbonate of lead consists of oxide of lead 66.0, carbonic acid 12, water 2.2. It accompanies the sulphuret of lead : primary form a right rhombic prism of 117° and 63°.

Sub. Spe. *Black Carbonate of Lead.* Color greyish-black or black, with considerable lustre : opake. It contains lead 75.0, oxygen 3.5, carbonic acid 18, water 2, carbon 1.5.

SPECIES V. CARBONATED MURIATE OF LEAD.

Color light-green, pale-yellow, and sometimes

colorless : transparent—translucent : brittle : lustre vitreous : structure foliated, parallel to the planes of a rectangular prism. Before the blow-pipe it melts into an orange colored globule. Sp. gr. 6.

It is composed of oxide of lead 83.5, muriatic acid 8.5, carb. acid 6.5.

SPECIES VI. SULPHATE OF LEAD.

Color white or grey, tinged with red, yellow, blue, or green : transparent—translucent : lustre vitreous or adamantine : insoluble in nitric acid. It may be reduced to a metallic state in the flame of a candle. Sp. gr. 6.3.

It is composed of oxide of lead 70.5, sulphuric acid 25.7, water 2. Primary form of its crystals an octaedron.

SPECIES VII. SULPHATO—CARBONATE OF LEAD.

Color whitish, bluish or greenish-grey : effervesces while dissolving in nitric acid, scarcely perceptible : softer than carbonate of lead. It fuses into a globule which is white when cold. Sp. gr. 6.8—7.

It consists of 53.1 of sulphate, and 47.9 carbonate of lead. Primary form of its crystal a right oblique angled prism.

SPECIES VIII. SULPHATO-TRI-CARBONATE OF LEAD.

It occurs in rhomboidal and prismatic crystals : color of the rhomboidal, pale greenish or yellowish, or brownish : the prismatic varieties colorless, or of various shades of pale yellow. Sp. gr. 6.3—6.5. It is not so hard as the sulphate of lead.

SPECIES IX. CUPREOUS SULPHATE OF LEAD.

Color *deep blue*, resembling the blue carb. of

copper: soft. Sp. gr. 5.3. It is composed of sulphate of lead 74.4, oxide of copper 18, water 4.7. Primary form a right oblique-angled prism.

SPECIES X. CUPREOUS SULPHATO—CARBONATE OF LEAD.

Color varies from blue to dark greenish blue: occurs in crystals generally minute: softer than carbonate of lead. Sp. gr. 6. 4.

It consists of 55.8 sulphate of lead, 32.8 carb. of lead, and 11.4 of carbonate of copper.

SPECIES XI. PHOSPHATE OF LEAD.

Color various, but usually some shade of green: brittle: lustre resinous: scratches carbonate of lead: transparent—translucent. Sp. gr. 6.4. Before the blowpipe it decrepitates and then melts; on cooling it assumes the form of a polyedron: if this globule is pulverized and mixed with borax and again exposed to heat, it first becomes milk-white, afterwards effervesces, and at length becomes transparent—the lower part of it being studded with globules of lead. It consists of oxide of lead 80, phosphoric acid 18. Primary form a regular six-sided prism.

SUB. SPE. *Arseniated Phosphate of Lead.* Color yellowish-green. Before the blowpipe it exhales the odor of arsenic, and yields a globule like the pure phosphate.

SPECIES XII. ARSENIATE OF LEAD.

Color pale-yellow: tender and easily broken: translucent—transparent: scratches glass. In nitric acid it does not effervesce. Before the blowpipe it exhales the odor of arsenic, and is reduced. Sp. gr. 5.6.

It is composed of oxide of lead 77.50, arsenic acid 19.05, muriatic acid 1.50.

SPECIES XIII. CHROMATE OF LEAD.

Color deep orange-green; in powder orange-yellow: fracture uneven—conchoidal, with a splendent lustre: translucent: brittle. When exposed to the blowpipe it crackles and melts into a greyish slag: to borax it imparts a green color, and is in part reduced. Sp. gr. 6. May be scraped by the nail.

It is composed of oxide of lead 63.96, chromic acid 36.40: primary form an oblique rhombic prism of 93° 30′ and 86° 30′.

Sub. Spe. *Cupreous Chromate of Lead.* Color green mixed with brown or yellow. It tinges borax green, and gives to nitric acid a red color, shaded with orange. It consists of oxide of lead 60.87, chromic acid 28.33, oxide of copper 10.80.

SPECIES XIV. MOLYBDATE OF LEAD.

Color wax-yellow, or orange or greenish yellow: translucent: brittle, and yields easily to the knife. Before the blowpipe it decrepitates: on charcoal it fuses into a dark grey mass, in which globules of reduced lead are visible. Sp. gr. 5.09.

It consists of oxide of lead 58.4, molybdic acid 38. It occurs in crystals of a tabular form, but its primary form is an octaedron with a square base.

SPECIES XV. TUNGSTATE OF LEAD.

It resembles some varieties of phosphate of lead: alone on charcoal it fuses and gives off the vapor of lead and with soda yields a large quantity globules of lead.

GENUS XII. TIN.

The ores of this substance are very few. It has never been found in a metallic state.

SPECIES I. OXIDE OF TIN.

Color some shade of brown: transparent—opake: scratches glass. Structure imperfectly foliated. Sp. gr. 6.7—7. Before the blowpipe it decrepitates strongly, but in fine powder it may be reduced.

It is composed of tin 77.5, oxygen 21.5. It is usually crystallized or in crystalline grains. Its primary form is an obtuse octaedron. Its crystals have the general form of prisms. The oxide of tin belongs almost exclusively to the oldest primitive mountains.

Sub. Spe. *Fibrous Oxide of Tin.* Color chesnut-brown. It is composed of reniform or globular masses, splitting into wedge-form fibrous pieces, lustre pearly.

It is composed of oxide of tin 91, oxide of iron 9: oxide of tin is sometimes columbiferous.

SPECIES II. PYRITOUS TIN.

Color steel-grey, more or less mixed with yellow: yields easily to the knife: lustre shining metallic: brittle. Melts into a blackish scoria, but is not reduced. Sp. gr. 4.3. It is composed of tin 26.5, copper 30, iron 12, sulphur 30.5.

GENUS XIII. ZINC.

It has not been found in a metallic state: its ores are not numerous.

SPECIES I. SULPHURET OF ZINC. *(BLENDE.)*

Color yellow, brown and black, of different

shades: lustre vitreous, adamantine, metallic and sometimes dull: structure foliated, and may be easily cleaved in six directions, parallel to the planes of a rhomboidal dodecaedron: infusible.

It is composed of zinc 58, sulphur 23.5, iron 8.4, silex 7. Sometimes sulphuret of zinc contains gold, silver, lead, arsenic and cadmium. Common in metallic veins of sulphuret of lead, in primitive mountains.

SPECIES II. RED OXIDE OF ZINC.

Color red, blood-red or aurora-red: powder brownish yellow: translucent: infusible: brittle and easily scratched by a knife. In powder with potash, it fuses into an emerald-green mass. Sp. gr. 6.2.

It is composed of zinc 76, oxygen 16, manganese and iron 8. It accompanies magnetic iron in calcareous rocks.

SPECIES III. FRANKLINITE.

Color iron-black: powder reddish-brown: fracture conchoidal: magnetic. Sp. gr. 4.87. When fusing the zinc is volatilized, leaving an alloy of iron and manganese.

It consists of oxide of zinc 17, iron 66. It accompanies the red oxide of zinc.

SPECIES IV. SILICEOUS OXIDE OF ZINC. *(CALAMINE.)*

Color white, or shades of yellow, brown and green: transparent—opake: infusible: it is scratched with a knife. Sp. gr. 3.45. In nitric acid it dissolves without effervescence, the solution becoming gelatinous. It is composed of oxide of zinc 38, silex 50, water 12. This mineral has *the aspect of a stone* rather than a metal.

SPECIES V. CARBONATE OF ZINC.

Its external characters are the same as the preceding species, only it is softer. In warm nitric acid it dissolves with effervescence, but the solution does not become gelatinous. Sp. gr. 4.3. It occurs in various forms, as crystallized, compact, earthy and pseudomorphous. Primary form an obtuse rhomboid of 106° 30′ and 73° 30′. It is composed of zinc 65.2, carb. acid 34.8. Sometimes contains cadmium. It is found in beds and veins in secondary limestone.

SPECIES VI. SULPHATE OF ZINC. (*WHITE VITRIOL.*)

Color white or grey: occurs massive, reniform and botryoidal: taste sharp and styptic. Sp. gr. 2. Fuses with ebullition, giving off large quantities of sulphurous acid, and leaving a grey scoria.

It is composed of oxide of zinc 27.5, sulphuric acid 22, water 50. It is found in mines which contain the sulphuret of zinc.

GENUS XIV. NICKEL.

Color of pure nickel intermediate between silver and pewter. Its ores are few and not abundant.

SPECIES I. NATIVE NICKEL.

Color bronze-yellow, or inclining to steel-grey. Before the blowpipe on charcoal it semi-fuses into an agglutinated mass, which is malleable and magnetic.

It occurs in capillary filaments; flexible, but not magnetic. It contains a little arsenic and cobalt.

SPECIES II. ARSENICAL NICKEL.

Color copper-red: becomes tarnished by exposure: opake. It gives sparks with steel, and yields

at the same time the odor of arsenic: brittle. Its solution in nitric acid affords a greenish deposit. Fused with difficulty into a scoria. Sp. gr. 6.6—7.5. It strongly resembles native copper, and the tarnished varieties of copper pyrites. It is composed of nickel 44.2, arsenic 54. It is found in primitive rocks, particularly in hornblende.

SPECIES III. ARSENIATE OF NICKEL.

Color fine apple-green: compact and friable. It is found adhering to arsenical nickel.

GENUS XV. COBALT.

It has not been found in a metallic state.

SPECIES I. ARSENICAL COBALT.

Of this there are three varieties.

Var. 1. *Bright white Cobalt.* Color silver-white with a tinge of red. Before the blowpipe on charcoal it blackens as it becomes red, but disengages arsenical fumes, and melts into a metallic globule which attracts the magnet, and tinges borax of a deep blue. Sp. gr. 6.3—6.5. It is composed of 44 cobalt, 65 arsenic. It resembles in its crystalline forms iron pyrites.

2. *Grey Cobalt.* Color externally greyish-black; on the fresh fracture steel-grey, with a metallic lustre: amorphous. Sp. gr. 5.5. It consists of cobalt 33.10, arsenic 43.47, iron 3.02, sulphur 20.0[illegible].

3. *Tin-white Cobalt.* Color tin-white. Before the blowpipe, on the first impression of heat, it gives off arsenical vapours, but melts with great difficulty, and does not become magnetic. Sp. gr. 7.3—7.7.

It is composed of cobalt 20.31, arsenic 74.21, iron 3.

SPECIES II. SULPHURET OF COBALT.

Color whitish with a tinge of yellow : structure granular—massive. Before the blowpipe it exhales the odor of sulphur, and melts into a brittle shining globule.

It is composed of cobalt 43, sulphur 38.5, copper 14.4, iron 3.53.

SPECIES III. OXIDE OF COBALT.

Color various shades of brown, blue, black and yellow : streak shining, and when rubbed by a smooth hard body, acquires a strong resinous lustre. Sp. gr. 2.42.

It is associated with the ores of iron, nickel, copper and silver.

SPECIES IV. SULPHATE OF COBALT.

Color pale rose-red : translucent and soluble in water : taste styptic. Its solution with carb. of potash, affords a pale bluish precipitate which tinges borax blue.

It consists of oxide of cobalt 38.7, sulphuric acid 19.74, water 41.55. It occurs in stalactites along with the ores of cobalt.

SPECIES V. ARSENIATE OF COBALT.

Color various shades of red, passing into crimson : softer than calcareous spar. To borax in infusion it communicates a fine blue. Sp. gr. 4.0—4.3.

It contains oxide of cobalt 39, arsenic acid 38, water 23. It accompanies the arsenical cobalt, and sometimes the ores of copper, nickel, lead and silver.

GENUS XVI. MANGANESE.

All its ores are combined with oxygen.

SPECIES I. SULPHURET OF MANGANESE.

Color brownish-black, but in the recent fracture dark steel-grey: fracture fine grained: fuses with difficulty into a scoria, giving out the smell of sulphur. To nitrous borax it communicates a fine purple.

It consists of protoxide of manganese 82, sulphur 11, carbonic acid 5.

SPECIES II. OXIDE OF MANGANESE.

Color iron-black or steel-grey: infusible: soft: streak dull black: yields oxygen gas when heated. It occurs massive and crystallized. Primary form right rhombic prism of 100° and 80°.

It consists of oxide of manganese 86.4, water 10, oxygen 3.5.

Sub. Spe. *Ferruginous Oxide of Manganese.* Color bluish-black: lustre feeble: streak shining: yields with difficulty to the knife: melts easily, and communicates to borax a violet-blue. Sp. gr. 4.75.

It is usually associated with brown oxide of iron.

SPECIES III. SILICEOUS OXIDE OF MANGANESE.

Color reddish-white or rose-red, and by exposure becomes black: translucent: scratches glass: becomes blackish, but does not fuse before the blowpipe.

It is composed of oxide of manganese 52.6, lox 39.6, oxide of iron 4.6.

SPECIES IV. CARBONATE OF MANGANESE.

Color of the recent fracture rose-red : by exposure to moisture it blackens : translucent : yields to the knife : structure small foliated, or its fracture is splintery : effervesces in powder with nitric acid. Sp. gr. 3.23.

It consists of oxide of manganese 48.0, carb. acid 49. It occurs in Cummington, Mass. in mica slate, and in loose masses.

SPECIES V. PHOSPHATE OF MANGANESE.

Color and other external characters like the carbonate of manganese. It fuses readily on charcoal with intumescence into a black globule, with a metallic lustre, and strongly magnetic. Sp. gr. 3.40—3.95.

It is composed of oxide of manganese 32.60, phosphoric acid 32.78, oxide of iron 31.70, phosphate of lime 3.20. It is found in granite.

GENUS XVII. ARSENIC.

SPECIES I. NATIVE ARSENIC.

Color on the recent fracture lead-grey, inclining to tin-white : structure foliated : yields to the knife and is brittle. Before the blowpipe it volatilizes, giving off a strong vapor possessing the odor of garlic. Sp. gr. 5.7. It is found in primitive rocks.

Sub. Spe. 1. *Sulphuret of Arsenic* (Realgar.) Color brilliant red, with a tinge of orange : translucent—transparent : easily impressed by the nail : cross fracture conchoidal. Sp. gr. 3.3. Burns with a yellow flame.

It consists of arsenic 69, sulphur 31. Primary

form oblique rhombic prisms of 105° 45′ and 74° 15′.

2. *Orpiment.* Color lemon-yellow. It occurs reniform in stalactites and in minute crystals. Sp. gr. 3.3.

It consists of arsenic 62, sulphur 38.

SPECIES II. OXIDE OF ARSENIC.

Color white : translucent—opake : taste acrid : soluble in water. Thrown on hot coals it gives off the fumes of arsenic, and is entirely volatilized.

It is associated with the ores of arsenic, cobalt and silver.

GENUS XVIII. BISMUTH.

SPECIES I. NATIVE BISMUTH.

Color silver-white, with a slight tinge of red. It melts in the flame of a candle : soft : sectile : structure large foliated. Sp. gr. 9.5—9.02.

It occurs in veins in primitive mountains. It generally contains arsenic. It resembles silver, but is not flexible.

SPECIES II. SULPHURET OF BISMUTH.

Color between tin-white and lead-grey : soft and brittle. It melts in the flame of the candle. Sp. gr. 6.11.

It consists of bismuth 60, sulphur 40. It occurs disseminated in crystalline prisms : often deeply striated lengthwise. It is associated with native bismuth.

Sub. Spe. 1. *Cupreous Sulphuret of Bismuth.* Color lead-grey, steel-grey and tin-white : often tarnished : fracture fine grained : lustre metallic : sectile. Rare.

It consists of bismuth 47.2, sulphur 12.6, copper 34.6.

2. *Plumbo-Cupreous Sulphuret of Bismuth.* Color steel-grey, with a yellowish tarnish : structure lamellar : lustre metallic : soft : melts into a grey globule and deposits a yellow powder : effervesces in nitric acid. Sp. gr. 6.12.

It consists of bismuth 43.2, sulphur 11.58, lead 24.32, copper 12.10.

SPECIES III. OXIDE OF BISMUTH.

Color greenish-yellow or yellowish-grey : structure lamellar, with shining lustre, and sometimes earthy and dull. Easily reduced to a metallic state by heat.

SPECIES IV. CARBONATE OF BISMUTH.

It is said to have the appearance of an earthy substance, and somewhat resembles steatite.

SPECIES V. ARSENICAL BISMUTH.

Color dark hair-brown : lustre resinous : brittle, soft and heavy : decrepitates before the blowpipe, and emits an arsenical odor, and with borax is converted into a glass which effervesces in acids.

GENUS XIX. ANTIMONY.

SPECIES I. NATIVE ANTIMONY.

Color tin-white : lustre strong metallic : structure perfectly lamellar in one direction : yields to the knife. Before the blowpipe it fuses with ease and volatilizes in grey inodorous vapor : if allowed to cool slowly the globule becomes covered with minute acicular crystals : brittle. Sp. gr. 6.7.

It sometimes contains arsenic. Rare.

SPECIES II. SULPHURET OF ANTIMONY.

Color lead-grey, often tarnished: soft and very brittle: structure foliated, granular and compact: melts in the flame of a candle. Sp. gr. 4.60.

It consists of antimony 74, sulphur 26. It occurs in veins in primitive rocks. It has a strong resemblance to sulphuret of lead.

SPECIES III. OXIDE OF ANTIMONY.

Color white, translucent: massive and earthy: sometimes in acicular crystals. Sp. gr. 5.56.

When in crystals it resembles stilbite.

SPECIES IV. SULPHURETTED OXIDE OF ANTIMONY.

Color deep cherry-red: opake: tender and friable: burns with a bluish flame before the blowpipe. Sp. gr. 4.0—4.6.

It consists of antimony 67.5, oxygen 10, sulphur 19.7. It is produced by the decomposition of the sulphuret of antimony.

GENUS XX. TELLURIUM.

It is always found in the metallic state, but is more or less alloyed by other metals.

SPECIES I. NATIVE TELLURIUM.

Color tin-white: lustre shining metallic: soft: structure foliated. Before the blowpipe it melts before ignition, and on the increase of heat, it burns with a greenish flame, and is almost volatilized in a dense white vapor, having a pungent odor like horse radish. Sp. gr. 6.2.

It is composed of tellurium 90.55, iron 7, gold 0.25. It resembles antimony.

Sub Spe. 1. *Auro-argentiferous native Tellurium.* Color tin-white: lustre strong metallic.

structure foliated: soft. It often occurs in 4 or 6-sided prisms, so arranged in rows that they resemble written characters. Sp. gr. 5.7.

It contains gold 30, tellurium 60, silver 10.

2. *Auro-plumbiferous native Tellurium.* Color silver-white, passing into yellow and grey, of different shades: soft and sectile. Sp. gr. 10.6.

It is composed of tellurium 44.75, gold 26.75, lead 19.5, silver 8.5.

SPECIES II. BLACK TELLURIUM.

Color between iron-black and dark lead-grey. Sp. gr. 8.00.

It consists of tellurium 32.2, lead 54, gold 9, sulphur 3.0.

GENUS XXI. CHROME.

This mineral is never found in a metallic state, and is with great difficulty reduced. Color greyish white: hard and brittle, with a radiated structure. Sp. gr. 5.9.

SPECIES I. OXIDE OF CHROME.

Color bright grass-green or pale-yellow: translucent: crystalline, earthy and dull. The green variety changes to yellow by heating: colors borax green: soluble in alkalies, and communicates to them a green color, and by continuing the boiling the oxide of chrome is precipitated.

Oxide of chrome and its combination with acids are useful as furnishing beautiful and durable pigments.

GENUS XXII. MOLYBDENA.

It is never found in a metallic state, and has scarcely been seen in a well reduced button. Color silver-white: hard and brittle. Sp. gr. 8.6.

SPECIES I. SULPHURET OF MOLYBDENA.

Color lead-grey with a metallic lustre: structure perfectly foliated in one direction; folia flexible, but not elastic: soils the fingers like plumbago. Before the blowpipe it exhales the odor of sulphur, but is infusible. It is soluble in carb. of soda, with violent effervescence. Sp. gr. 4.04—4.73.

It consists of molybdena 60, sulphur 40. It belongs to the oldest of the primitive rocks.

The metallic molybdates display considerable diversity of color, some of which are lively and permanent.

SPECIES II. OXIDE OF MOLYBDENA.

Color straw or orange-yellow. It has the form of a dull powder, and occurs as a crust upon the sulphuret. It has not been analyzed.

GENUS XXIII. TUNGSTEN.

Its characters as a pure metal are hardly known. Color steel-grey: hard and brittle. Sp. gr. 17.33.

SPECIES I. OXIDE OF TUNGSTEN.

Color orange or chrome-yellow: brittle: lustre adamantine: infusible and insoluble in acids; but readily soluble in warm liquid ammonia, and is precipitated white by acids, but the precipitate becomes yellow on standing.

SPECIES II. TUNGSTATE OF IRON. *(WOLFRAM.)*

Color brownish-black or deep brown: structure foliated: lustre metallic: powder deep reddish-brown. Before the blowpipe it decrepitates and easily melts into a scoria: not magnetic. It occurs massive and crystallized. Primary form a right oblique angled prism. Sp. gr. 7.1—7.3.

It is composed of tungstic acid 78.77, protoxide of iron 18.32, protoxide of manganese 6.22, silex 1.25. It occurs only in primitive rocks. It resembles magnetic oxide of iron.

SPECIES III. TUNGSTATE OF LIME.

Color greyish or yellowish-white : translucent : yields easily to the knife : decrepitates before the blowpipe, but does not melt. Sp. gr. 5.—5.6.

It consists of tungstic acid 80.41, lime 19.46. It occurs massive and crystallized. Primary form an octaedron of 128° 40'. It resembles sulphate of barytes, and is only found in primitive rocks.

GENUS XXIV. TITANIUM.

Its properties as a pure metal are hardly known.

SPECIES I. RED OXIDE OF TITANIUM.

Color reddish-brown, or varies from blood-red to copper-red, and sometimes on the surface steel-grey : translucent—opake : lustre metallic : scratches glass : infusible without addition, but with borax melts into a transparent reddish-yellow glass. Sp. gr. 3.8.

It occurs generally in prismatic crystals, striated longitudinally and often geniculated. Primary form an octaedron. Belongs to primitive rocks.

SPECIES II. FERRUGINOUS OXIDE OF TITANIUM.

Color brownish-black : imperfectly foliated : scratches glass : brittle : lustre glimmering and adamantine : not magnetic : infusible alone, but with borax melts into a hyacinth-red globule. Sp. gr. 4.4.

It consists of oxide of titanium 84, oxide of iron and manganese 16. There are three varieties of

this substance, viz. *Menachanite*, *Iserine* and *Nigrine*.

SPECIES III. CRICHTONITE.

Color varies from steel-grey to velvet-black: harder than fluate of lime, but does not scratch glass: fuses with difficulty. Nothing is known for certainty of this mineral, but it is supposed to be a silicate of titanium.

SPECIES IV. SPHENE. *(SILICO CALCAREOUS OXIDE OF TITANIUM.)*

Color some shade of yellow or brown: structure distinctly foliated in two directions: scratches glass: it fuses into a dark brown enamel: it is usually in the form of flat four-sided prisms. The primary form is an oblique rhombic prism of 133° 30′ and 46° 30′.

It consists of oxide of titanium 35, silex 35, lime 33. It occurs in primitive rocks, associated with hornblende, epidote, pyroxene, &c.

SPECIES V. OCTAEDRAL OXIDE OF TITANIUM.

Color blue, of various shades, or brown, blackish-brown: fuses with an equal quantity of borax into an emerald-green glass, and on cooling crystallizes in needles. Rare.

GENUS XXV. URANIUM.

The properties of metallic uranium have been but little examined. Color dark-grey, with a metallic lustre.

SPECIES I. BLACK OXIDE OF URANIUM.

Color brown, greyish, brownish-black and

black : opake : lustre often resinous : infusible, but with borax it yields a grey slag. Sp. gr. 7.5.

It consists of oxide of uranium 86.5, galena 6, oxide of iron 2.5, silex 5.

SPECIES II. PHOSPHATE OF URANIUM.

Color lemon-yellow, gold-yellow, apple and emerald-green : brittle and easily scraped with a knife : structure in one direction perfectly foliated : transparent—opake. With borax it gives a yellowish-green glass. The saturated solution with nitric acid is lemon-yellow.

It consists of uranium 60, oxide of copper 9, phosphoric acid 15.3, water 13.8. Primary form a right square prism. It is generally found in granite.

GENUS XXVI. COLUMBIUM.

The ores of this metal are few, and occur sparingly.

SPECIES I. FERRUGINOUS OXIDE OF COLUMBIUM.

Color dark bluish-grey, or nearly iron-black : opake : scratches glass. Alone before the blowpipe it suffers no change, but with borax it dissolves slowly but perfectly. Sp. gr. 6.46—7.

It consists of oxide of columbium 83.2, protoxide of iron 7.2, protoxide of manganese 7.4, oxide of tin 0.6. It occurs in crystals and crystalline masses. The primary form is said to be a right rectangular prism. Very rare.

SPECIES II. YTTRIOUS OXIDE OF COLUMBIUM.

Color iron-black ; when in powder, greyish : yields to the knife : opake. Before the blowpipe decrepitates, and finally melts into a greenish-yellow slag. Sp. gr. 5.1.

It consists of oxide of Columbium 45, yttria and oxide of iron 5.5. Both species have only been found in primitive rocks.

GENUS XXVII. CERIUM.

Its characters as a pure metal are almost unknown. Its ores are very scarce, and indeed nothing satisfactory concerning a part of them has been published.

SPECIES I. SILICEOUS OXIDE OF CERIUM.

Color varies from pale rose-red to brown: streak greyish: scratches glass: tough. Before the blowpipe it splits but does not fuse: with borax it fuses slowly. Sp. gr. 4.48—4.98.

It consists of oxide of cerium 54.5, silex 34.5, oxide of iron 3.5, lime 1.25, water 5. It is found in gneiss, associated with mica and hornblende.

SPECIES II. ALLANITE.

Color brownish-black: powder greenish-grey: opake: about as hard as glass, and brittle. Before the blowpipe it becomes greenish-yellow on the surface, but does not fuse. Sp. gr. 3.5.

SPECIES III. ORTHITE.

Always occurs in straight seams or layers, sometimes in feldspar. Alone before the blowpipe it intumesces and fuses into a black blebby glass: with borax it dissolves readily into a glass, which is red when hot, and yellow when cold.

It is composed of protoxide of cerium 19.50, protoxide of iron 12.44, protoxide of manganese 3.41, silex 32, alumine 14.80.

Another variety of orthite has received the name of pyrorthite, from the circumstance of its taking

fire and burning before the blowpipe. It contains about 25 per cent of carbon.

SPECIES IV. FLUATE OF CERIUM.

There are several varieties.

Var. 1. *Neutral, or Deuto-Fluate of Cerium.* Color red, more or less deep: infusible, but turns brown before the blowpipe.

It is composed of fluate of protoxide of cerium 30.4, fluate of peroxide of cerium 68.00. It occurs in six-sided prisms in plates and amorphous masses.

2. *Sub-Fluate of Cerium.* Color yellow: infusible. It contains twice as much oxide of cerium as the preceding.

3. *Yttrious Fluate of Cerium.* Color pale yellow or deep red, and sometimes reddish-brown, and even white: very soft. It occurs in amorphous masses, of the size of a pea.

Sub Spe. *Yttrocerite.* Color violet, greyish-red, greyish-white, and these often mingled in the same specimen: opake: yields to the knife, but scratches fluor spar: infusible alone, but on the addition of gypsum it readily melts into a bead.

It consists of fluate of lime 68.18, fluate of yttria 10.60, fluate of cerium 20.22.

GENUS XXVIII. SELENIUM.

Color grey, with a metallic lustre: powder red: yields to the knife and is brittle: colors the flame of the blowpipe blue, and exhales the odor of horse raddish: melts at about 212°. While cooling it may be drawn like wax. Sp. gr. 4.6.

It resembles sulphur.

GENUS XXIX. CADMIUM.

Color, lustre, hardness and ductility resemble tin: melts below red heat. In air it suffers no change. Sp. gr. 8.63—9.05.

It exists in several ores of zinc, particularly the brown fibrous blende.

CLASS III.

Includes those Minerals which consist of an alkaline or earthy Base in combination with Acids.

ORDER I. Alkaline Salts.

GENUS I. AMMONIA.

This alkali when not combined, exists in a gaseous state, and has occasionally been observed in mineral waters.

SPECIES I. SULPHATE OF AMMONIA.

Taste sharp and bitter. When triturated with pure lime it is decomposed, and the odor of ammonia becomes perceptible. Sulphuric acid does not act upon it.

It consists of ammonia 14.24, sulphuric acid 54.66, water 31 10. It is found in the vicinity of volcanoes, frequently forming a yellowish crust on lava and ejected stones.

SPECIES II. MURIATE OF AMMONIA.

Taste sharp and urinous. Ammoniacal gas is evolved when triturated with quicklime. Sulphuric acid decomposes it and disengages the muriatic acid. Sp. gr. 1.55.

It consists of ammonia 25.00, muriatic acid 42. 75, water 32.25. Usually found in the vicinity of volcanoes.

GENUS II. POTASH.

SPECIES I. NITRATE OF POTASH. *(SALTPETRE.)*

Taste sharp and cooling. When placed on hot coals it produces a vivid combustion and a hissing noise. Sp. gr. 1.9.

It is composed of potash 46.5, nitric acid 53.5. It is found in the fissures of calcareous rocks, sides of caverns, and in soils which are much mixed with animal and vegetable matter. Valuable in the arts, medicine, &c

SPECIES II. SULPHATE OF POTASH.

Taste saline, bitter and disagreeable : color white, yellowish or greyish-white, a little shining : transparent—translucent : lustre vitreous, inclining to resinous : brittle : may be scratched by the nail. Sp. gr. 1.73.

It consists of sulphuric acid 45.93, potash 54. 07. It occurs at Mount Vesuvius.

GENUS III. SODA.

SPECIES I. SULPHATE OF SODA. *(GLAUBER'S SALTS.)*

Taste at first saline and cooling, afterwards bitter.

It consists of sulphuric acid 24.76, soda 19.24, water 56. It is often contained in mineral waters.

SPECIES II. MURIATE OF SODA. *(COMMON SALT.)*

This salt is easily distinguished by its well known saline taste. It has a distinct and easy cleavage parallel to all the planes of the cube.

It is composed of muriatic acid 38.88, soda 53. 00, water 8.12.

SPECIES III. CARBONATE OF SODA. *(SODA OF COMMERCE.)*

Taste warm, alkaline and not very caustic : color greyish-white : effervesces in acids : soluble in water.

It is composed of carbonic acid 14.16, soda 20. 6, water 65.24. It is found in crusts or efflorescences on warm and dry soils.

SPECIES IV. BORATE OF SODA. *(BORAX.)*

Taste alkaline. It changes the vegetable blues to green. It does not effervesce in acids. Before the blowpipe it swells and melts into a glassy globule.

It consists of boracic acid 37.0, soda 14.5, water 4.7.

SPECIES V. NITRATE OF SODA.

Color white : streak white : translucent : lustre vitreous : fracture conchoidal : soft : sectile : taste cooling. It is soluble in three times its weight of water. It melts and deflagrates on glowing charcoal, but not so violent as nitre. Sp. gr. 2.09.

It consists of nitric acid 54.97, soda 43.03. It occurs in beds with clay in Peru, S. A.

SPECIES VI. SULPHATE OF SODA AND MAGNESIA.

Color between flesh-red and brick-red : translucent, becoming opake-white by decomposition : lustre faint, vitreous : structure columnar : fracture splintery : soft.

It consists of sulphate of magnesia 36.66, sulphate of soda 33.34, protosulphate of manganese 0.33, muriate of soda 22.00, water 0.34.

ORDER II. EARTHY SALTS.

GENUS I. BARYTES.

SPECIES I. SULPHATE OF BARYTES. *(HEAVY SPAR.)*

Color pure white, or tinged with yellow and red, and sometimes blue, green or brown : structure generally foliated : harder than calc. spar, and softer than fluor spar : transparent—opake. Before the blowpipe it decrepitates, and melts into a solid enamel, which after a few hours, falls to powder, and imparts the taste of putrid eggs. Sp. gr. 4.29—4.60.

It is composed of barytes 68, sulphuric acid 32. It usually occurs in veins, traversing primitive, and secondary rocks, and these veins are often rich in ores. It is useful as a flux.

There are several varieties which have received descriptive names, as *lamellar, columnar, radiated, fibrous, concreted, granular, compact* and *earthy Sulphate* of *Barytes.* It is often crystallized : the primary form is a right rhombic prism of 101° 32′ and 78° 28′.

SUB SPE. *Fetid Sulphate of Barytes.* It has most of the characters of the species, but usually of less specific gravity. By friction or the application of heat, it exhales the odor of putrid eggs.

It is composed of sulphate of barytes 85.25, sulphate of lime 6.0, oxide of iron 6.

SPECIES II. CARBONATE OF BARYTES.

Structure between fibrous and narrow foliated : fibres slightly diverging : lustre glistening and vitreous : if pure, it dissolves entirely with effervescence in nitric acid. Before the blowpipe it decrepitates and easily melts into a white enamel ; but does not lose its carbonic acid. If a small

quantity of nitrate of barytes be added to alcohol, it burns with a yellowish tinge. Sp. gr. 4.2—4.4.

It is composed of barytes 78, carbonic acid 22. It occurs massive, stalactitic and crystallized. Its primary form is supposed to be a right rectangular prism. Poisonous to animals.

SPECIES III. BARYTO-CALCITE.

Color white, greyish, yellowish, or greenish: streak white: translucent—transparent: lustre vitreous, inclining to resinous: equals fluor spar in hardness; and before the blowpipe it is infusible, but with borax it melts into a clear globule. Sp. gr. 3.66. It consists of carbonate of barytes 65.9, carbonate of lime 33.6.

GENUS V. STRONTIAN.

SPECIES I. SULPHATE OF STRONTIAN.

Color some variety of white, red, blue or grey: lustre pearly. It is easily scratched by the knife. Before the blowpipe it melts into an opake white enamel, which excites a slightly sour taste; and if the globule be dissolved in a drop of muriatic acid, and a drop of alcohol be added, a splinter of wood dipped in the solution burns with a red flame. Sp. gr. 3.58—3.96.

It consists of strontian 54, sulphuric acid 46. It occurs foliated, fibrous and crystallized. The primary form is a right rhombic prism of 104° and 76'. It is found in transition rocks.

SPECIES II. BARYSTRONTIANITE.

Color greyish-white externally, yellowish-white internally, and appears somewhat disintegrating: lustre feebly shining: translucent: brittle and soft: effervesces with acids, but is infusible.

It consists of carbonate of strontian 68.6, sulphate of barytes 27.5, carbonate of lime 2.6.

SPECIES III. CARBONATE OF STRONTIAN.

Color greenish or yellowish-white: translucent: fracture perpendicular to the direction of the fibres is uneven or splintery: lustre resinous. It communicates a reddish purple color to the flame of the blowpipe, and when gently heated swells and sends out minute filaments, of which the extremities only are melted. The fragment becomes white and opake. It dissolves with effervescence in nitric acid, and a paper dipped in this solution, dried and burned, gives a purple flame. Sp. gr. 3.4—3.8. It is found in primitive rocks, along with galena, sulphate of barytes, &c. It is a rare mineral.

GENUS VI. LIME.

SPECIES I. CARBONATE OF LIME.

The numerous minerals comprehended under the term carbonate of lime, present considerable diversity of external characters: they all yield to the knife: effervesce in acids; are infusible, and have a specific gravity under 3.0.

Sub Spe. 1. *Calcareous Spar.* (Calc. Spar.) Limpid, white or tinged with yellow: structure foliated: cleaves easily in three directions parallel to the faces of an obtuse rhomboid of 104° 05′, and 75° 55′. Sp. gr. 2.68—2.74.

It consists of lime 57, carbonic acid 43.

2. *Granular Limestone.* Color snow-white, grey, and often tinged with various other colors: structure granular, coarse or fine, often resembles white sugar: translucent. It is a little harder than

calc. spar, and is susceptible of a good polish. It is usually associated with primitive rocks.

3. *Fibrous Limestone.* (Satin Spar.) Color white, reddish-white, grey and green: structure fibrous, and usually strait: sometimes divergent: lustre pearly. It is found in thin seams traversing other calcareous rocks.

4. *Compact Limestone.* Color grey, but occurs of most all colors: structure compact, but the fracture is splintery and dull: texture often close, like wax, but sometimes earthy.

It is an impure carbonate of lime, containing from 2—12 per cent of silex, alumine, iron, &c.

5. *Blue Vesuvian Limestone.* Color bluish-grey, sometimes veined with white: opake: fracture fine grained and splintery.

It is composed of lime 58, carbonic acid 28.5, water 11, silex 1.25. It occurs in rounded specimens among those minerals which have been ejected from Vesuvius.

6. *Chalk.* Color usually white, often with a tinge of yellow, and sometimes brown: always amorphous, with a dull earthy fracture. Sp. gr. 2.25—2.66.

It is an impure carbonate of lime, containing minute quantities of alumine and oxide of iron.

7. *Agaric Mineral.* It is composed of fine white earthy particles which have only a slight coherence: texture spongy.

Results from the disintegration of other varieties of carbonate of lime.

8. *Concreted carbonate of Lime.* Colors various: structure crystalline: external form imitative: fracture presents parallel layers, whether straight, undulated or concentric.

Var. 1. *Oolite.* It occurs in globular masses, varying in size from a poppy seed to a pea: composed of concentric parallel layers, enclosing a small compact nucleus. An impure carbonate of lime.

2. *Pisolite.* It is composed of concretions similar to the oolite, but they enclose a grain of sand; usually about the size of a pea.

3. *Calcareous Sinter.* This term embraces most of the imitative forms under which carbonate of lime appears—as stalactical, tuberose, mammillary, reniform, globular, cylindrical, tubular, branched and undulated masses.

Stalactites are those icicle-like projections from the roofs of caves. They exhibit a structure with diverging fibres, and pearly lustre. They are formed by the infiltration of carbonated water, containing carbonate of lime in solution, through pores or fissures in the roofs of caverns. The water having percolated through the roof, remains suspended in drops: the water evaporates, and the calcareous particles are deposited on the roof in the form of little rings, which extend by degrees till a small tube or solid projection is formed, when a part of the water falls to the floor; it then forms the *stalagmite.* These deposits are essentially composed of parallel layers, almost always undulated, and conformable to the surface on which they rest.

4. *Calcareous Tufa.* It consists of porous or spongy matter, deposited from water; and is in fact only an earthy precipitate. It is an impure carbonate of lime, containing sand, leaves, roots, mosses, stems of vegetables, shells, &c. Calcareous incrustations are a kind of tufa.

Sub Spe. 9. *Argentine.* Color white, often with a slight shade of red, grey, yellow and green: structure always distinctly slaty, sometimes parallel; but they often separate, forming little cells, which are studded with minute crystals of quartz: lustre pearly. Sp. gr. 2.64. It is nearly a pure carbonate of lime.

Var. Aphrite. It occurs in tender friable masses, composed of talc-like scales, and of a silvery lustre.

Sub Spe. 10. *Magnesian carbonate of Lime.* The varieties of carbonate of lime containing magnesia, effervesce moderately in acids; and when in fine powder become milky by the addition of diluted acids.

Var. 1. *Rhomb Spar.* It occurs massive and in single crystals: structure always foliated, parallel to the sides of an obtuse rhomb of 106° 15′, and 73° 45′. It is harder than calcareous spar: lustre more pearly, and more resembles feldspar: color white, yellowish-white or brown: translucent in different degrees. Sp. gr 2.8.

It is composed of carbonate of lime 52, carbonate of magnesia 45, oxide of iron 3. It is usually embedded in talcose or serpentine rocks

2. *Dolomite.* Structure granular, either coarse or fine: solid—friable: the grains have a lamellar structure: translucent. p. gr. 2.85. Slabs of dolomite are often flexible.

Magnesian carbonate of lime is generally connected with primitive strata. It burns to lime, which is caustic, and unfit for agricultural purposes.

Sub Spe. 11. *Brown Spar.* (Pearl Spar.) Color

white or grey, either pure or tinged with yellow or red: structure foliated, and the folia are always curved: lustre more or less pearly, and often metallic: harder than calc. spar. Before the blowpipe it becomes dark brown. Sp. gr. 2.83—3.00. It occurs massive and crystallized. It is composed of lime 27.97, magnesia 21.14, carbonic acid 44.6, oxide of iron and manganese 4.54. It passes into the carbonate of iron. It occurs in the geodiferous lime rock, and in metallic veins with the sulphurets of lead and zinc.

12. *Siliceous carbonate of Lime.* It has a close resemblance to a sand-stone. It is crystallized in rhombs, or presents itself in mammillary concretions, or in amorphous masses: opake and greyish-white: surface imparts a harsh feeling to the fingers, peculiar to silex. It contains about one third carbonate of lime, and the rest is silex. It is sometimes called the stone of *Fontainbleau.*

13. *Madreporite.* Color greyish-black. It occurs in roundish masses, composed of prismatic diverging concretions: fracture indistinctly lamellar, somewhat curved: lustre dull—splendent: opake. Sp. gr. 2.7. When rubbed it emits a fetid odor.

14. *Fetid carbonate of Lime.* Color usually dark. When broken or rubbed by a pointed body, it exhales the odor of sulphuretted hydrogen. By calcination it loses its color and odor, and yields good lime. There are some limestones which on being scraped by a pointed body, give the precise smell of the sea.

15. *Bituminous carbonate of Lime.* Color usually black: odor, when scraped or broken, bituminous. By calcination it loses its color and odor.

16. *Ferruginous carbonate of Lime.* Color dark or blackish-grey, but unequally diffused: scratches carbonate of lime. Sp. gr. 2.81. Before the blowpipe it melts into a black glass, and is attracted by the magnet. In powder, it slowly dissolves in nitric acid, with effervescence.

17. *Calp.* Color bluish-grey or bluish-black: odor argillaceous when breathed on: tougher than carbonate of lime, and when burnt is of a buff color. It is composed of carbonate of lime 68.0, silex 18.0, alumine 7.5, bitumen 3, iron 2. The Lias limestone is also argillo-ferruginous. Some varieties furnish a cement which hardens under water. It is used in the lithographic art.

18. *Marl.* This substance has the usual appearance of clay. It is essentially composed of carbonate of lime and clay in various proportions. Some marls are indurated, others are earthy.

Var. 1. *Indurated Marl.* It is always cut easily with a knife: lustre dull like clay or chalk: opake: fusible and effervesces in acids. Sp gr. 2.3—2.7.

2. *Septaria.* Occurs in nodules, or oval masses, of various sizes. These masses are traversed by seams of calc. spar, barytes, or some substance, in every direction: thus dividing the mass into distinct partitions, or septæ: color brownish, and the substance is both argillaceous and ferruginous. It is used to furnish a valuable cement, called *Parker's cement.*

3. *Earthy Marl.* It differs from indurated marl in being friable or of a loose texture. Marl is an important mineral for the improvement of soils.

Sub Spe. 19. *Bituminous Marlite.* Color greyish or brownish-black : structure slaty : opake : it effervesces in acids. Before the blowpipe it burns with a small flame, yielding a bituminous odor, and melts into a black scoria. It is soft. Sp. gr. 2.38.

It occurs in secondary rocks.

SPECIES II. ARRAGONITE.

Colors white, grey, yellow ; or yellowish-green, blue, and sometimes violet or reddish : structure in some varieties coarsely fibrous, with a silky lustre : yields to the knife, but is brittle and nearly as hard as glass : translucent—transparent, and possesses double refraction. In nitric acid it dissolves slowly with effervescence. Sp. gr. 2.9. When insulated and pressed between the fingers it becomes electric.

It is composed of carbonate of lime 94.5, carbonate of strontian 3.9.

This mineral occurs massive, or in the form of small branches, consisting of fibrous crystals, which diverge from a centre ; and also in irregular six-sided prisms, discovering a re-entering angle down each face : primary form a right rhombic prism of 116° 5′ and 63° 55′.

SPECIES III. PHOSPHATE OF LIME.

Color white, yellowish-white, green, blue, greenish-blue and red : lustre when crystallized vitreous : transparent—opake : structure imperfectly foliated parallel to the lateral and terminal planes of a regular six-sided prism. Before the blowpipe a minute fragment may be fused. In nitric acid it dissolves slowly without effervescence. It may be scratched by a knife. Sp. gr. *3.02—3.21.*

Var. 1. *Apatite.* Structure parallel to the bases of the primary form more distinctly foliated than in the direction of the sides: phosphorescent on hot coals. It is composed of lime 55, phosphoric acid 45.

2. *Asparagus Stone.* Color asparagus-green: transparent—translucent. It often presents the six-sided prism, terminated by pyramids, whose faces correspond to the lateral faces of the prism, and form with them an angle 129° 14'. It does not phosphoresce on hot coals. It is composed of lime 54.28, phosphoric acid 44.72.

3. *Fibrous phosphate of Lime.* It is composed of fibres radiating from a centre: phosphorescent. Rare.

4. *Massive phosphate of Lime.* Color greyish, yellowish, or reddish-white: structure lammellar, either curved or diverging: opake. Its powder phosphoresces on hot coals, with a greenish-yellow light. It contains lime 59, phosphoric acid 34.

5. *Pulverulent phosphate of Lime.* It occurs in an earthy state: phosphorescent on a hot iron.

Sub Spe. *Siliceous phosphate of Lime.* Color grey, shaded with violet: gives sparks with steel: fracture earthy, granular and a little foliated: phosphoresces strongly on hot iron.

Phosphate of lime when crystallized, has a great resemblance to beryl; though the characters given will sufficiently distinguish it. It is found usually in primitive strata. The asparagus stone has been found in volcanic rocks.

SPECIES IV. FLUATE OF LIME.

Color white, grey, and various shades of blue,

red, yellow and purple; and sometimes black: transparent—opake: it may be scratched by iron: yields easily to mechanical division parallel to the planes of a regular octaedron. The fumes which are disengaged by the action of warm sulphuric acid, corrode glass or siliceous substances. Sp. gr. 3.09—3.20.

It is composed of lime 67.75, fluoric acid 32.25. It occurs compact, massive, earthy and crystallized; and is remarkable for the beauty, size and perfection of its crystals, and the ease with which they yield to mechanical division. All its varieties phosphoresce when placed on a hot shovel, and the variety which has received the name of *Chlorophane*, phosphoresces with an emerald-green light.

Fluate of lime is manufactured into vases, plates, &c. for ornamental purposes: it is likewise used for etching on glass. It is found in primitive and transition rocks; and is usually associated with metallic substances, sulphate of barytes, phosphate of lime, quartz, &c.

SPECIES V. SULPHATE OF LIME.

Color white, grey, flesh-red, &c.: transparent—opake: may be scratched by the nail. Before the blowpipe it melts into a white enamel, which in a few hours falls to powder. It does not effervesce in acids, nor burn to lime. Sp. gr. 3.00.

Sulphate of lime consists of lime 32, sulphuric acid 47, water 21. It is soluble in about 500 parts of water. There are several varieties deserving notice.

Var. 1. *Selenite.* Limpid: lustre shining and pearly: structure foliated. It occurs in flattish

crystals. Its primary form is a right oblique angled prism, of which the bases are oblique angled parallelograms of 113° 8' and 66° 52'. It cleaves with ease and brilliancy, parallel to the terminal planes. The laminæ are flexible but not elastic.

2. *Fibrous Gypsum.* It occurs in extremely delicate fibres, either straight or curved: lustre pearly.

3. *Granular Gypsum.* It occurs in granular masses, coarse and fine; but having a foliated structure: lustre shining, or only glimmering. It resembles granular limestone.

4. *Earthy Gypsum.* It occurs in loose earthy particles or scales, which are dull, or possess a glimmering lustre.

Gypsum, or sulphate of lime, is found in transition and secondary rocks. It is associated with compact limestone, sand stone, muriate of soda, and with strata of marly clay.

SPECIES VI. ANHYDROUS SULPHATE OF LIME.

Color white, grey, blue, violet or red: lustre shining and pearly: sometimes limpid and transparent. It scratches crystallized carbonate of lime, but yields easily to the knife. Before the blowpipe it does not exfoliate and melt like the preceding species, but the whole surface is converted into a friable white enamel: structure foliated, and when crystallized its laminæ easily separate in three directions, perpendicular to each other; but the terminal planes are more brilliant than the lateral. Sp. gr. 2.5.

It is composed of lime 40, sulphuric acid 60. It sometimes absorbs water and passes into the common variety called by Hauy, *epigene*. The following varieties deserve notice:

Var. 1. *Sparry Anhydrite.* Colors white and grey, with shades of blue, red or yellow. It occurs in laminated masses and crystals, whose form is a rectangular four-sided prism, differing but little from the cube. Its lustre on the broader faces of the crystals or laminæ is strongly shining and pearly. It contains one per cent of muriate of soda. (Muriacite.)

2. *Granular Anhydrite.* Its masses are composed of granular concretions, whose structure is confusedly lamellar.

3. *Fibrous Anhydrite.* The fibres which compose its masses are parallel or diverging: lustre pearly.

4. *Compact Anhydrite.* It occurs in compact, globular and reniform masses.

The anhydrite is found in beds along with gypsum, muriate of soda, &c.

Sub Spe. *Silico-Anhydrous sulphate of Lime.* It is found in distinct massive concretions, of a laminated structure: translucent on the edges: splendent, soft and brittle; and of a greyish-white color, veined with bluish-grey.

It consists of sulphate of lime 92, silex 8. It is the *Marmo bardiglio di Bergamo* of artists. It takes a fine polish.

SPECIES VII. SILICEOUS BORATE OF LIME.

Color greyish or greenish-white: translucent: fracture imperfectly conchoidal, with a vitreous lustre: it yields to the knife: in the flame of a candle it becomes opake and friable Before the blowpipe it intumesces into a small white mass, and then melts into a pale rose-red globule Sp. gr. 3.

It is composed of lime 34, boracic acid 21.67, silex 37.66, water 5.5. It occurs massive and crystallized. Its primary form is a right rhombic prism of about 103° 40′ and 76° 20′. It resembles greenish quartz. The lustre of the natural planes of the crystal is more dull than the fracture. It is found in greenstone.

Var. Botryolite. It occurs in mammillary concretions, formed of concentric layers; having a fibrous texture. Before the blowpipe it melts into a white glass.

SPECIES VIII. NITRATE OF LIME.

Taste bitter and disagreeable: on burning coals it melts slowly with a slight detonation, and as it dries, loses its acid. Deliquescent and soluble in water.

It consists of lime 32, nitric acid 57.44, water 10.56. It is found in efflorescence and silken tufts, on old walls, in caverns, and on calcareous rocks.

SPECIES IX. MURIATE OF LIME.

Taste sharp and bitter: very soluble in water, and deliquescent: crystallizes in six-sided prisms.

It is abundant in nature, forming a part of sea-water, brine-springs, and likewise those waters denominated *hard*. Also considerably abundant in the marly clay. (London clay.)

SPECIES X. ARSENIATE OF LIME.

Color white, sometimes with a shade of grey, blue or yellow; but is often colored violet by the arseniate of cobalt. It is tender and easily broken: lustre silky. Before the blowpipe the arsenic acid is volatilized, with the odor of arsenic,

but the lime remains pure : dissolves without effervescence in acids. Insoluble in water. Sp. gr. 2.64.

It is composed of lime 25.00, arsenic acid 50.54, water 24.46. It is associated with the arseniate of cobalt, sulphates of lime and barytes. Rare.

GENUS VII. MAGNESIA.

This genus contains three species, no one of which occurs in great quantities.

SPECIES I. SULPHATE OF MAGNESIA. *(EPSOM SALTS.)*

Taste bitter : transparent : lustre silky. Dissolves in its own weight of water at 60°.

It consists of magnesia 18, sulphuric acid 38, water 44. It occurs in efflorescences or in masses, composed of acicular crystals, and is sometimes disseminated in the soil, or dissolved in water. Valuable in medicine as a purgative.

SPECIES II. CARBONATE OF MAGNESIA.

Color usually perfectly white : infusible : sulphuric acid dissolves it entirely with effervescence, forming epsom salts.

Var. 1. *Crystallized carbonate of Magnesia.* It usually occurs in delicate acicular crystals, diverging from a centre : lustre pearly.

2. *Compact carbonate of Magnesia.* Texture compact, or finely granular : fracture dull, earthy and splintery. When recently broken scratches calc. spar. Color white. Sp. gr. 2.88.

3. *Pulverulent carbonate of Magnesia.* White, soft, and when dry falls to powder without friction.

Carbonate of magnesia is found in transition serpentine, in horizontal veins, at Hoboken, N. J.

SPECIES III. BORATE OF MAGNESIA. (*BORACITE.*)

Color yellowish, greyish or greenish-white: lustre glistening; usually translucent, and sufficiently hard to give sparks with steel. It fuses with ebullition into a yellowish glass. It does not dissolve in cold acids. Sp. gr. 2.56.

It is composed of magnesia 16.6, boracic acid 83.4. It occurs always in crystals, whose general form is a cube, imbedded in gypsum.

GENUS VIII. ALUMINE.

SPECIES I. MELLATE OF ALUMINE.

Color honey-yellow, sometimes tinged with brown, red or yellow: translucent: softer than amber: crystallizes in obtuse octaedrons: burns without flame or smoke, and acquires the color and consistence of chalk.

It consists of mellitic acid and water 84, alumine 16. It occurs on bituminous wood and on earthy coal. Is generally accompanied by sulphur.

SPECIES II. PHOSPHATE OF ALUMINE.

Color grey, or greenish white: lustre silky: translucent—opake: scratches calc. spar: infusible, but becomes white, opake, and gives a slight greenish tinge to the flame of the blowpipe. It is soluble in the stronger acids. Sp. gr. 2.22—2.7.

It is a sub-phosphate of alumine, consisting of alumine 35.35, phosphoric acid 33.40, fluoric acid 2.06, oxide of iron and manganese 1.25, water 26. 90. It is found in globular masses, composed of

minute radiating crystals. The primary form is a rhombic prism of 122° 15′ and 57° 45′. It is found in cavities and veins in clay slate, and likewise in granite.

SPECIES III. SUB-SULPHATE OF ALUMINE. (*ALUMINITE.*)

Color white or yellowish-white: opake: soft, dull, and yields to the nail: it adheres to the tongue, and has a meagre touch: infusible, but loses 70 per cent of its weight. When viewed with a magnifying glass, it appears composed of minute prisms. Sp. gr. 1.67—1.70.

It consists of alumine 30.2, sulphuric acid 23.4, water 46.4. It is found with selenite in a calcareous loam.

SUB SPE. *Siliciferous sub-sulphate of Alumine.* Color between snow and milk-white. It has the consistence of hog's lard. On drying, it splits into columns like starch.

It consists of water 88.1, alumine 6.5, sulphuric acid 3.0, silex 2.4. It was found forming a thin bed on an argillaceous rock, in Lancashire, Eng.

ORDER IV.

Salts with an alkaline and earthy Base.

SPECIES I. SUB-SULPHATE OF ALUMINE AND POTASH.

Color white: structure compact, or porous. When calcined and lixiviated, it yields alum.

SUB SPE. *Siliceous sub-sulphate of Alumine and Potash.* Color white or grey, sometimes shaded with yellow, red or brown: fracture uneven and earthy: structure compact or porous like burhstone: opake or feebly translucent: friable, but sometimes gives sparks with steel. Insoluble in

water. When calcined and lixiviated, it yields alum by crystallization. Sp. gr. 2.42—2.77.

It is composed of alumine 43.92, potash 3.08, sulphuric acid 25.0, water 4, silex 25.00.

SPECIES II. SULPHATE OF ALUMINE AND POTASH. *(ALUM.)*

Taste sweetish and astringent: color white, tinged with grey, yellow or green: soluble in three-fourths its weight of boiling water. When thrown on hot coals it loses its water of crystallization, and then dries into a white spongy mass. Sp. gr. 1.7.

It is composed of alumine 10.50, potash 10.40, sulphuric acid 3.52, water 48.58. It appears in efflorescences of capillary crystals on clay slate.

SPECIES III. FLUATE OF SODA AND ALUMINE. *(CRYSOLITE.)*

Color white, greyish-white and milk-white: lustre vitreous: structure foliated, parallel to the sides of a rectangular parallelopiped: translucent, and when plunged in water it becomes limpid and transparent. Before the blowpipe it dissolves in its own water of crystallization, as suddenly as ice. Sp. gr. 2.95.

It is composed of alumine 24, soda 36, fluoric acid and water 40. It occurs in thin layers in gneiss, associated with carbonate of iron, &c.

SPECIES IV. GLAUBERITE.

Limpid or pale reddish-yellow, and retains its transparency unless moistened: harder than sulphate of lime, but is scratched by carbonate of lime: becomes milky-white when immersed in water: structure foliated, with a conchoidal fracture. Before the blowpipe it splits, decrepitates, and melts into a white enamel. Sp. gr. 2.73.

It is composed of anhydrous sulphate of soda 51, anhydrous sulphate of lime 49. It is found disseminated in muriate of soda.

SPECIES V. POLYHALITE.

Color brick-red, from the presence of iron: structure fibrous, either parallel or curved: scratches the anhydrite: brittle: lustre pearly. It melts instantaneously before the blowpipe, and in the flame of a candle it becomes an opake, brownish mass. It is slightly acted on by exposure. Sp. gr. 2.77.

It contains sulphate of lime, 28.26, anhydrous sulphate of lime 22.42, anhydrous sulphate of magnesia 20.03, sulphate of potash 27.70, muriate of soda 0.19, oxide of iron 0.34. It is found in muriate of soda.

SPECIES VI. AMBLYGONITE. *(SUB-PHOSPHATE OF ALUMINE AND LITHIA.)*

Color greenish-white, or mountain or sea-green. It occurs in rhombic prisms of 106° 10′, and 73° 50′, which are rough. It cleaves parallel to the sides of the prism, with brilliant surfaces. Hardness between feldspar and quartz: on charcoal it fuses readily into a transparent colorless glass, which becomes opake on cooling. Sp. gr. 3.00.

It consists of alumine, lithia, phosphoric and fluoric acids. It occurs in the newer granite, with tourmaline, topaz, &c.

CLASS IV.

Includes those Minerals which consist of an Earth, or are compounds of Earths, with variable portions of Alkalies and metallic Oxides.

For convenience, this class is divided into sections, according to their specific gravity, hardness and fusibility.

SECTION I.

Specific gravity under 2.75. Hardness superior to glass. Infusible.

SPECIES I. QUARTZ.

Colors numerous: lustre varies from dull to perfect vitreous: amorphous and crystallized: transparent—opake. Mean sp. gr. of the species 2.60.

Quartz is essentially composed of silex; but often contains the oxides of metals as coloring matter, which causes considerable diversity in the external characters. To facilitate the description of the species, it may be separated into two divisions.

Division I. *Quartz susceptible of crystallization, and having a fracture more or less vitreous.*

Sub Spe. 1. *Common Quartz.* Translucent—transparent: often limpid: colors white or grey; often tinged with yellow, orange-red, green, blue, &c. By friction it exhales a peculiar odor, and some varieties also phosphoresce in the dark. Sp. gr. 2.69.

Transparent quartz is composed of silex and 2 or 3 per cent of water, which is supposed to vary according to the dryness of the atmosphere. Oc-

curs massive and crystallized : primary form is a rhomboid of about 94° 15', and 85° 45'. The finest crystals are found in cavities in primitive rocks, and in alluvial earths.

Quartz seems to be universally distributed.

Var. 1. *Smoky Quartz.* Objects seen through this variety appear to be viewed through a cloud of smoke. Its true color seems to be clove-brown or wine-yellow.

2. *Yellow Quartz.* (False Topaz.) Color varies from pale-yellow to yellowish-red, and nearly opake.

3. *Rose Quartz.* Color pale-rose, or flesh-red : hardly transparent.

4. *Aventurine Quartz.* Color is variegated by brilliant points or spangles, which shine with a silver or golden lustre. Employed in jewellery.

5. *Milky Quartz.* Color bluish-white : nearly opake. Traverses argillite in veins.

6. *Greasy Quartz.* Color various : surface appears as if besmeared with oil.

7. *Radiated Quartz.* It occurs in masses, composed of imperfect prisms, closely applied to each other, and terminating in pyramids at the surface.

8. *Granular Quartz.* Color white or yellowish white : structure presents granular concretions which have but little cohesion. It is usually dull and sometimes flexible, when cut into thin tables.

9. *Arenaceous Quartz.* It is in loose grains, coarse or fine, and constitutes some varieties of pure sand.

10. *Pseudomorphous Quartz.* There are two kinds, one which is formed around other crystals,

and is left hollow; the other which occupies the moulds of former crystals, and is solid. The false crystals have a dull surface, and blun'ed edges, and may be cubes, rhomboids, octaedrons, &c.

11. *Tabular Quartz.* It is composed of plates applied to each other, by their broader planes, or they intersect each other, so as to form cells or cavities.

12. *Globular Quartz.* This new and singular variety of quartz occurs in globular or spheroidal masses, having a perfect resemblance to a well fused glass. Their size varies from an eighth of an inch to half an inch in length. Some specimens present the angles and corners of crystals in one part, while others are rounded, or appear fused. They scratch glass, and contain small fragments of anthracite.

This interesting variety is found in Palatine, N. Y. about one mile north of the Noses.

13. *Amethyst* or *Violet Quartz.* Color violet-blue of different shades, but not of equal intensity throughout. Sometimes it is white. It is best characterized by its coarse fibrous structure. It receives its coloring from the oxides of iron and manganese. It occurs in greenstone, amygdaloid and porphyry.

14. *Brown Quartz.* Color garnet-brown: translucent: lustre resinous. It is quartz colored by titanium, and sometimes it encloses crystals of the same substance.

15. *Prase.* Color leek-green or olive-green, and is uniformly diffused. It is colored by actynolite, which often appears in distinct capillary crystals.

16. *Ferruginous Quartz.* Color various shades of yellow and red, which is uniformly diffused. It occurs amorphous and crystallized. The red crystallized variety is called the *hyacinth* of *Compostella.* It is sometimes found in masses, composed of minute crystals and crystaline grains. It occurs brick-red and pale-yellow in Pittsfield, Mass.

17. *Stalactitic Quartz.* It consists of straight stalactites, composed of an aggregation of crystals diverging from a centre, the pyramids appearing on the surface. It is found in Middlefield, Mass. in serpentine.

18. *Fetid Quartz.* Color grey: translucent: lustre resinous. When struck with a hammer it exhales the odor of sulphuretted hydrogen. It occurs in the coarse grained marble of Chester, Mass.

19. *Striated Quartz.* Color grey. It presents striæ which mark the direction of natural joints, in the direction of which a slight blow of the hammer causes a separation of laminæ in a rhombic form.

Division II. *Includes those minerals which are nearly pure silex, but have never been seen crystallized.*

Sub Spe. 2. *Cat's Eye.* Color various shades of grey, green, brown or red; and it exhibits a peculiar play of light, resembling the eye of a cat. It is quartz penetrated by amianthus, which gives it a fibrous appearance: scratches quartz: translucent. Sp. gr. 2.7.

It is composed of silex 95, alumine 1.75, lime 1.5, oxide of iron 0.25. It is found in alluvial deposits, and is employed in jewelry.

3. *Chalcedony.* It is best characterized by its peculiar milky-white color: but it includes several varieties which agree with it in its general characters, and differ only in color. Common chalcedony is harder than quartz, always translucent, and appears in some imitative form, as globular, reniform, botryoidal; fracture fine-splintery, with little or no lustre: surface always rough. Sp. gr. 2.65.

It is composed of silex 84, alumine 16. It sometimes appears in pseudomorphous crystals.

Chalcedony belongs principally to trap rocks, but is sometimes found in veins and cavities in primitive, as in primitive serpentine, in Middlefield, Mass.

Var. 1. *Cacholong.* Color bluish-white: fracture conchoidal: structure compact. Generally less hard than quartz and is nearly opake and dull: often adheres slightly to the tongue. Sp. gr. 2.2.

It is associated with chalcedony, and the two minerals pass into each other by insensible shades.

2. *Carnelian.* Color red, sometimes has a shade of yellow-brown, or is nearly white. Its colors and different shades appear in spots, or stripes, and gradually pass into each other. Fracture conchoidal with a glistening lustre: translucent. Sp. gr. 2.61.

3. *Sardonyx.* Color yellow or reddish-yellow. It consists of carnelian and chalcedony in alternate layers or stripes.

4. *Plasma.* Color dullish-green, with yellow and whitish dots.

It has not been analyzed. It is found in s

pentine, along with hornstone. It is supposed to be colored by chlorite.

5. *Heliotrope.* Color mostly deep-green, and translucent, and commonly yellow or blood-red spots are interspersed through its substance. It has been called *bloodstone.*

6. *Chrysoprase.* Color apple-green and translucent: massive: lustre glimmering: fracture even. It has about the hardness of quartz. Sp. gr. 2.71.

Its color is produced by the oxide of nickel.

Sub Spe. 4. *Siliceous Sinter.* This sub species includes the siliceous deposits, which have a loose or porous texture, sometimes more or less compact, and sometimes fibrous. Color white, yellowish-white or grey: lustre dull or pearly.

Var. 1. *Hyalite.* It bears a strong resemblance to gum arabic, and occurs in botryoidal masses or in stalactites: lustre vitreous; is brittle, but has the hardness of quartz.

It is composed of silex 92, water 6, and with a trace of alumine. It is found investing cavities in amygdaloid, and in the burhstone of Georgia.

2. *Michaelite.* It occurs in delicate and coarse fibres, from one to four inches long, so crossing and interlacing as to form a net work: lustre pearly: color greyish-white. Sp. gr. 1.88.

It consists of silex 83.65, water 16.35. It is associated with siliceous sinter, in the island of St. Michael.

Sub Spe. 5. *Opal.* Opal like quartz consists principally of silex, but contains a greater quantity of water: has a resinous lustre, and is not sufficiently hard to give sparks with steel. It is divided into the following varieties:

Var. 1. *Precious Opal.* Color white, bluish or yellowish-white. It exhibits brilliant and changeable reflections of green, blue, yellow and red. This play of color is supposed to be owing to the refraction and reflection of light from numerous fissures. Translucent: fracture conchoidal: brittle but scratches glass. Sp. gr. 2.11.

It occurs in veins in clay porphyry, traversing primitive rocks.

2. *Fire Opal.* It differs from the precious in possessing only a red reflection when turned towards the sun, or a strong light.

3. *Common Opal.* Color various shades of white, green, yellow and red, but is entirely without the play of colors.

4. *Semi-Opal.* It is more opake than common opal. It occurs of various shades of white, yellow, grey, brown and green: fracture flat, conchoidal: fragments sharp and translucent.

It occurs in silver veins, traversing granite and gneiss.

5. *Wood-Opal.* Remarkable for its wood-like appearance, but differs from petrified wood in being translucent, lighter, and admitting of a conchoidal fracture.

6. *Ferruginous Opal.* Color red, yellow, or grey: scarcely translucent on the edges: fracture conchoidal: lustre resinous.

It is composed of silex 43.5, oxide of iron 47, water 7.

Sub Spe. 6. *Menilite.* Color smoke-brown or yellowish-brown: cross fracture flat conchoidal: lustre resinous: structure slaty.

It consists of silex 85.5, water 11, alumine 1. It occurs in thin layers in argillaceous marly clay.

7. *Flint.* Color usually some shade of grey, light or dark : fracture perfectly conchoidal : lustre feeble or only shining : always gives sparks with steel, and its splinters or fragments are always sharp. Sp. gr. 2.58—2.63.

Flint is mostly confined to secondary rocks, as chalk, and is usually in nodules, which are incrusted with calcareous matter. They occur in parallel beds, mostly horizontal.

8. *Hornstone.* Colors numerous and dull. It is often grey, blue, yellow, brown and black : fracture splintery, and scarcely conchoidal : thin fragments strongly translucent. It is less hard than flint.

It is often imbedded in rounded and irregular masses, in compact limestone. It is composed of silex 71.3, alumine 15.3, protoxide of iron 9.3.

9. *Buhrstone.* It occurs in amorphous masses, partly compact, but always containing irregular rough cavities. These cavities are sometimes crossed by siliceous threads, forming a net work.

It belongs to the tertiary formation.

10. *Jasper.* The most common colors are red, yellow, brown, and sometimes green. It is usually dull and opake : structure perfectly compact : fracture flat conchoidal. Sp. gr. 2.5.

It usually contains 12 or 13 per cent of oxide of iron.

Var. 1. *Striped Jasper.* Its colors are arranged in stripes, in parallel layers.

2. *Agate Jasper.* Color pale yellowish or reddish-white : several colors occur together, irregularly arranged.

It occurs in layers in agate balls, in amygdaloid.

Sub Spe. 11. *Leelite.* Color pink-red: lustre and translucency like horn: fracture splintery and conchoidal. Sp. gr. 2.71.

It contains silex 75.0, alumine 22, oxide of manganese 2.71.

Appendix to Quartz.

AGATE.

Agate is not a simple mineral; but is composed of carnelian, jasper and chalcedony, arranged in stripes, spots or zones. There are several varieties which have received descriptive names.

Var. 1. *Ribband Agate.* Consists of alternate and parallel layers of chalcedony, amethyst, jasper or quartz.

2. *Fortification Agate.* Consists of zig-zag zones, forming an enclosure resembling a fortification.

3. *Moss Agate.* Consists of chalcedony and irregular veins of red jasper, penetrated by vegetable ramifications, resembling moss.

Dr. McCulloch is of opinion that these appearances are owing to the existence of aquatic confervæ. Agates are found in trap rocks, as greenstone, amygdaloid, and likewise in solid masses on the banks of rivers.

Agates are used both in the useful and ornamental arts—for wheel pivots in watches, for mortars, boxes, seals, &c.

SPECIES II. SILICEOUS SLATE.

Color grey, bluish-grey and red: structure somewhat slaty. It is best characterized by the

seams of quartz, which traverse it in every direction. Becomes lighter colored before the blowpipe.

Var. 1. *Basanite or Lydian-stone.* Color dark bluish-grey and nearly black; never slaty; but is less hard than the common variety.

SPECIES III. TRIPOLI.

Color grey, often tinged yellow or red: fracture dull and earthy: opake. Tripoli differs from clay by the roughness and hardness of its powder, and not forming a paste with water. Sp. gr. 2.20.

It is composed of silex about 90 per cent.

It can hardly be considered a distinct species, as it results from the alteration of other minerals, either by fire or water.

It is found among secondary rocks, or in alluvial earths. Useful in polishing metals, stones, and glass.

SPECIES IV. LEUCITE. *(WHITE GARNET.)*

Color generally of a dirty white or grey: translucent: fracture imperfectly conchoidal; with a vitreous lustre. It usually appears in crystals, whose planes are similar and equal trapeziums. It is but little harder than glass. Sp. gr. 2.37.

It consists of silex 53.75, alumine 24.62, potash 21.35.

It abounds in the lavas of Vesuvius, and basalts of Italy and Bohemia.

SPECIES V. INDIANITE.

Color whitish or greyish, but sometimes tinged brown: lustre shining: translucent. It is scratched by feldspar. Sp. gr. 2.74.

It cleaves into prisms of 95° 15′ and 84° 45′. It is composed of silex 42.5, alumine 37.5, lime 15, iron 3. It constitutes the gangue of corundum, from the Carnatic.

SPECIES VI. EMERALD.

Color a pure, beautiful green, of various degrees of intensity: Translucent—transparent: structure parallel to the planes of a six-sided prism, indistinctly foliated: lustre vitreous: often longitudinally striated: fracture imperfectly conchoidal. Sp. gr. 2.67.

Sub Spe. *Beryl.* Color greyish-green, always pale, and of unequal intensity. Sometimes bluish-green or yellowish-green: prisms often intersected by seams, perpendicular to the axis: structure more distinctly foliated than the emerald: scratches quartz with ease: usually crystallized, but sometimes amorphous: crystals rarely modified by truncations. The emerald and beryl differ from each other principally in the intensity of color and perfection of their crystals. Crystals of emerald are small, while those of beryl are frequently very large. Emerald consists of silex 64.5, alumine 16, glucine 13, lime 1.6, oxide of chrome 3.25. Beryl is composed of silex 68, alumine 15, glucine 14, lime 2.

Emerald and beryl belong exclusively to primitive rocks.

SPECIES VII. SPINELLANE.

Color greyish-black, passing into ash-grey or brown: lustre vitreous, inclining to resinous: fracture conchoidal, uneven: transparent—opake: scratches glass with difficulty. Sp. gr. 2.28.

It consists of silex 43, alumine 29.50, lime 1.50, soda 19.00, oxide of iron 2.00, sulphur 1.00, water 2.50.

The crystals are rhombic dodecaedrons, elongated, so as to seem to be six-sided prisms, with triedral terminations.

It is associated with quartz, hornblende, magnetic iron, &c.

SECTION II.

Specific gravity under 2.75. *Hardness superior to glass. Fusible.*

SPECIES I. PUMICE.

Color greyish-white, sometimes shaded with yellow or blue; also brown, reddish-brown, greenish and black, or greyish-black; structure usually fibrous, rarely compact: fuses into a greenish-white globule. Sp. gr. 0.91—1.4.

It is composed of silex 77.5, alumine 17.5, potash and soda 3, iron 1.75.

Pumice is considered as a volcanic production.

SPECIES II. OBSIDIAN. *(VOLCANIC GLASS.)*

Color greenish or brownish-black: lustre vitreous: fracture large conchoidal: brittle. Sp. gr. 2.35.

It yields on analysis, silex 78, alumine 10, lime 1, potash 6, soda 1.6. It always has some resemblance to glass. It is most common in the neighborhood of volcanoes.

Var. 1. *Pearlstone.* This variety of obsidian has a granular structure, the grain consisting of very thin concentric layers. Color white and pearly: brittle. Sp. gr. 2.25—2.54.

It consists of silex 75.25, alumine 12.00, potash 4.50, water 4.

SPECIES III. PITCHSTONE.

Colors numerous, as various shades of grey, blue, green, yellow, red, brown, black, but never lively: lustre resino-vitreous: fracture imperfectly conchoidal: opake, or only translucent at the edges: fuses into a grey enamel. Sp. gr. 2.32—2.64.

It consists of silex 73, alumine 14, lime 1, soda 1.75, water 8.5. It is found in granite, and also in trap rocks of doubtful origin, and in lavas.

SPECIES IV. CLINKSTONE.

Color dark-greenish, yellowish or ash-grey. When struck with a hammer it gives a ringing metallic sound: brittle; and translucent on the edges. Sp. gr. 2.57.

Clinkstone is usually columnar, and frequently rests on basalt. It consists of silex 57.25, alumine 25.50, lime 2.75, soda 8.1, oxide of iron 3.25.

SPECIES V. NEPHELINE.

Color white: streak-white: fracture conchoidal: lustre vitreous: translucent—transparent: brittle: surface smooth and even. It yields before the blowpipe a blebby glass. When immersed in nitrous acid it becomes cloudy, and is finally converted into a jelly. Sp. gr. 2.56.

It is composed of alumine 49, silica 46, lime 2, oxide of iron 1. Some varieties contain manganese and potash. It is found in the granular limestone of Mount Somma, and in the lava of Capo di Bove. It occurs in grains and regular six-sided

prisms, which is the primary form. It resembles phosphate of lime, or small crystals of beryl.

SPECIES VI. FELDSPAR.

Of this important mineral there are several varieties; all of which agree in many characters. They are constituted of the same ingredients, and vary but little in relative proportion. All the varieties are less hard than quartz.

Var. 1. *Adularia.* Color greyish or greenish-white, or milk-white, and is frequently iridescent: translucent: lustre pearly, and often splendent: and exhibiting, especially when polished, a bluish or greenish-white chatoyant reflection of light. It melts into a white transparent glass. Sp. gr. 2.54. It is composed of silex 64, alumine 20, lime 2, potash 14. It occurs in granite, gneiss, clay slate, and limestone.

2. *Common Feldspar.* Color whitish, yellowish, blue, green, and sometimes reddish: translucent—opake: lustre on the lamellar fragments metallic: structure distinctly foliated in directions perpendicular to each other; in the other direction the cleavage is indistinct. It fuses into a translucent glass. Phosphoresces by friction in the dark. Sp. gr. 2.43—2.74.

It yields by analysis silex 62.83, alumine 17.02, lime 3, potash 13. It occurs massive, granular, and crystallized. Primary form a doubly oblique prism.

Feldspar is almost universally diffused. It forms a large and essential part of granite and gneiss. It abounds in some of the hornblende rocks, and constitutes the greater part of real lava. It is often subject to decomposition, more or less rapid,

and passes into a kind of clay, called porcelain clay, or petuntze, from the circumstance of its entering largely into the composition of porcelain ware. In this state it is infusible by the blowpipe, soils the fingers, has a dull earthy fracture, and usually embraces small masses of quartz. Sp. gr. 2.21. It consists of silex 52.0, alumine 37, iron 6.33.

3. *Green Feldspar.* Color apple-green, but usually unequally diffused.

4. *Glassy Feldspar.* It is characterized by the high vitreous lustre of its laminæ. It occurs imbedded in porphyry in the form of four-sided prisms.

5. *Aventurine Feldspar.* Colors various. It is characterized by containing little points or spangles, which reflect light strongly from a reddish or whitish ground.

6. *Opalescent Feldspar.* Color grey, often dark-grey. It is distinguished by the property of reflecting light of different colors, which appear to proceed from the interior.

7. *Granular Feldspar.* This variety seems to be an alteration merely of common feldspar, by partial decomposition. It is made up of grains which have but little cohesion.

8. *Compact Feldspar.* Color grey, white, green or red, and sometimes variously intermingled: texture more or less compact: lustre dull, or only glimmering. Sp. gr. 2.60—2.74.

Compact feldspar is associated with primitive, transition, and secondary rocks, both in beds and veins. It is sometimes used for hones, &c.

9. *Fetid Feldspar.* (Necronite.) It possesses the common characters of feldspar, but when pounded or scraped it exhales a fetid odor, like carrion.

It is associated with primitive limestone, with tremolite, mica, sulphuret of iron, &c.

SPECIES VII. CLEAVELANDITE. *(ALBITE.)*

Color white, or bluish-white: translucent—opake: brittle: structure foliated, parallel to the planes of a doubly oblique prism, yielding in one direction angles of 93° 30′, and 86° 30′. It is not so easily fused as feldspar, but gives the same results. Sp. gr. 2.33.

It consists of silex 70.7, alumine 19.8, soda 9, lime 0.2, oxide of manganese 0.1.

It is found in coarse grained granite, along with green, blue and red tourmalines. It always occurs in plates, applied to each other on their broader planes, and sometimes presents uniform or stellular groups.

SPECIES VIII. PETALITE.

Color greyish-white, greyish or greenish: structure lamellar in one direction, and it admits of cleavage parallel to the sides and both diagonals of a rectangular prism, apparently with oblique summits: translucent: lustre glistening—pearly. On charcoal it fuses with difficulty into a blebby glass. Sp. gr. 2.62.

It consists of silex 79.2, alumine 17.2, lithia 5.7.

SPECIES IX. ICE SPAR.

Color greyish-white: translucent—transparent: brittle: lustre shining like ice. It cleaves paral-

lel to the planes of a right oblique angled prism. Fuses with difficulty on the edge of the fragment into a blebby transparent glass. Ice spar occurs in white transparent crystals, greatly resembling adularia or glassy feldspar, but inplanted in drusy cavities of rocks, ejected from Mount Vesuvius.

SPECIES X. SCAPOLITE.

Color white, yellowish-white or grey, and sometimes purple: lustre pearly and vitreous, or dull. It fuses with violent intumescence into a semi-transparent glass, which appears light and spongy: translucent—opake. When crystallized it yields a mechanical division parallel to the planes and diagonals of a square prism. It equals feldspar in hardness, and often resembles it. It is sometimes compact. Sp. gr. 2.61.

It is composed of silex 40.53, alumine 32.72, lime 24, potash and soda 1.81, protoxide of iron 0.18. Terminal faces of the pyramid stand on the faces of the prism.

SPECIES XI. NUTTALLITE.

Color grey: lustre vitreous: crystals right square prisms, imbedded in calcareous spar: opalescent on the faces of the prism: softer than scapolite, and more glassy in its fracture: but has a close resemblance to it in many of its characters.

SPECIES XII. DIPYRE.

Color reddish-white. Like the preceding it scarcely differs from scapolite; and yields about the same results before the blowpipe and by analysis.

SPECIES XIII FETTSTEIN.

Color bluish-grey, passing into blue and green,

or brick-red passing into grey and brown : translucent : lustre resinous. It fuses into a blebby colorless glass. It possesses natural joints parallel to all the planes and both diagonals of a right rhombic prism of 112° and 68°. Sp. gr. 2.61.

It is composed of silex 46.50, alumine 30.25, lime 0.75, potash 18.00, oxide of iron 1.00, water 2.00. Its powder forms a jelly with acids.

It occurs in sienite or hornblende rocks along with titanium and zircon. Resembles scapolite.

SPECIES XIV. MEIONITE.

Color whitish or greyish-white : translucent—transparent : lustre vitreous. Before the blowpipe it intumesces and easily melts into a colorless blebby glass. It cleaves parallel to the sides of a four-sided prism. Sp. gr. 2.6.

It is composed of silex 40.8, alumine 30.6, lime 22.1, soda and lithia 02.4, oxide of iron 01.0. Resembles scapolite, but the terminal faces of the pyramid stand on the solid angles of the prism.

SPECIES XV. LAUMONITE.

Color white, sometimes passing into reddish, yellowish or greenish tints : translucent—transparent : effloresces on exposure to air : yields to mechanical division parallel to the lateral planes and both diagonals of an oblique rhombic prism. Before the blowpipe it fuses into a colorless blebby glass.

It is composed of silex 48.30, alumine 22.70, lime 12.10, water 16. It falls into a white powder similar to decomposed glauber salts.

It has been found in Connecticut in trap rocks.

SPECIES XVI. ANALCIME.

Color white, grey, yellowish, reddish or deep red: transparent—opake: fracture uneven. It occurs massive and crystallized. Primary form a cube: sometimes each solid angle is replaced by three planes, which when extended so that the primary faces disappear, forms the trapezoedron. Before the blowpipe it becomes transparent, and then fuses without intumescence into a diaphanous glass. Sp. gr. 2.06.

It is composed of silex 58, alumine 18, soda 10, lime 2, water 8.50. It occurs in granite, gneiss and trap rocks.

SPECIES XVII. SODALITE.

Color green, greenish-white, passing into greyish and snow-white: fracture uneven—conchoidal: surface smooth, rather uneven. Lustre vitreous: streak white: translucent. Cleavage dodecaedron, perfect: brittle. Before the blowpipe it melts with intumescence into a colorless glassy globule. Sp. gr. 2.29.

It consists of silex 36, alumine 32, soda and a little potash 25, muriatic acid 6.75. The fresh fracture often presents a beautiful crimson-red. It occurs in mica slate, associated with pyroxene, amphibole, &c.

SPECIES XVIII. SORDAWALITE.

Color greenish or greyish-black: opake: fracture conchoidal: massive: lustre vitreous, inclining to semi-metallic. It becomes reddish by exposure to the atmosphere. Before the blowpipe it forms with difficulty a blackish globule; with borax a green glass. Sp. gr. 2.53.

It consists of silex 49.40, alumine 13.80, peroxide of iron 18, magnesia 10.67, phosphoric acid 2.68, water 4.38.

SPECIES XIX. FAHLUNITE.

Color olive-green and oil-green, passing into yellow, brown and black : streak greyish-white : feebly translucent on the edges—opake : lustre vitreous : fracture conchoidal—uneven—splintery. Before the blowpipe it becomes pale-grey, and melts on the thinnest edges. It is not generally crystalline. Sp. gr. 2.61—2.66.

It consists of silex 46.79, alumine 26.73, magnesia 2.97, protoxide of iron 5.01, water 13.50.

It occurs at Fahlun, in Sweden, in a slaty talcose rock, in layers one fourth of an inch thick.

SPECIES XX. BERGMANITE.

Color several tints of grey, passing into white and brick-red : opake : not brittle : sometimes scratches quartz. Before the blowpipe it whitens and then melts without intumescence into a colorless glass. Sp. gr. 2.30.

It is associated with feldspar, which it resembles.

SPECIES XXI. SPHAERULITE.

Color various shades of brown and grey : translucent on the edges—opake : it scratches quartz slightly. Before the blowpipe the edges only become covered with an enamel. Sp. gr. 2.52—2.40.

It is said to be related to obsidian in respect to composition. It occurs imbedded in pitchstone and obsidian, in sphaeroidal masses.

SPECIES XXII. ANORTHITE.

Color white : streak white : translucent—transparent : lustre pearly on the cleavage planes, vitreous in other directions : brittle. Before the *blowpipe it* resembles feldspar.

It is composed of silex 44.49, alumine 34.46, lime 15.68, magnesia 5.26, oxide of iron 0.74.

It is found lining cavities in limestone along with pyroxene. It resembles albite or cleavelandite.

SPECIES XXIII. MELLILITE.

Color internally reddish-yellow, externally brownish: translucent at the edges: scratches steel. It occurs in small crystals which are nearly square prisms. Before the blowpipe it melts without ebullition into a greenish glass.

It consists of silex 38, lime 19, magnesia 19.40, alumine 2.90, oxide of iron 12.10, oxides of titanium and manganese 6.

It is found near Rome in volcanic rocks.

SECTION III.

Specific gravity under 2.75. *Less hard than glass. Fusible.*

SPECIES I. CHABASIE.

Color greyish-white, sometimes pale-red or yellowish, superficially: translucent—transparent: may be scraped with the knife, but when found in primitive rocks it makes some impression with the sharp corners on glass. It cleaves parallel to the sides of a very obtuse rhomboid of 94° 46′ and 86° 14′. It melts easily before the blowpipe into a spongy white enamel. Sp. gr. 2.7.

It consists of silex 43.33, alumine 26.6, lime 3.34, potash and soda 9.34, water 21.

Usually found in trap rocks, but sometimes in primitive, as in mica slate, at Chester, Mass.

SPECIES II. STILBITE. *(RADIATED ZEOLITE.)*

Color white, sometimes a little reddish on the

surface : lustre pearly : translucent—transparent : structure foliated parallel to the planes of a right prism with rectangular bases : exfoliates on hot coals : it easily melts into a colorless blebby glass, and easily yields to the knife. Sp. gr. 2.5.

It is composed of silex 50.2, alumine 29.3, lime 9.46, water 10.

It occurs in fasciculated and radiated masses in primitive and secondary rocks, with chabasie and heulandite.

SPECIES III. MESOTYPE.* *(MEALY ZEOLITE.)*

Color white or greyish-white : translucent—transparent : scratches calc. spar. It cleaves parallel only to the sides of a prism of 91° 20′ and 88° 40′. Brittle : fracture conchoidal, uneven. Before the blowpipe it becomes opake, then vitrifies without intumescence. Sp. gr. 2.24.

It is composed of silex 54.46, alumine 19,70, soda 15.09, lime 1.61. It occurs fibrous, which consists of radiating fibres, the centre being often compact, while the surrounding part is soft and apparently decomposed, and in a mealy state.

Var. 1. *Natrolite.* Occurs in mammillary masses, which when broken present a fibrous structure : the fibres diverging, of a pearly lustre, are white, brown or yellowish, disposed in alternate zones around the centre. Before the blowpipe it yields the same results as the mesotype. Sp. gr. 2.2.

It is composed of silex 48, alumine 25.24, soda 16.50, water 9, oxide of iron 1.75.

2. *Needlestone.* Occurs massive and in long slender prisms, terminated by qudrilateral pyra-

* Signifying a mean form between Stilbite and Analcime.

mids. It cleaves parallel to the sides of a very slightly rhombic prism, agreeing in measurement with the mesotype : translucent or transparent, or colorless : lustre pearly. Sp. gr. 2.26.

It is composed of silex 45.8, alumine 26.50, lime 9.87, soda 5.40, water 12.30. It is associated with stilbite.

SPECIES IV. THOMSONITE.

Color white : translucent—transparent : lustre vitreous inclining to pearly : brittle : cleaves readily parallel to the planes of a rectangular four-sided prism, excepting the terminal planes. It scratches fluor spar. Before the blowpipe it swells and curls, but scarcely melts, the edges only becoming rounded and shining like enamel. Occurs in trap rocks.

It is composed of silex 36.8, alumine 31.36, lime 15, magnesia 0.20, water 13.

SPECIES V. HEULANDITE. *(FOLIATED STILBITE.)*

Color white, yellowish and brownish, and sometimes deep red : translucent—transparent : lustre highly pearly. It commonly occurs in crystals, in the form of a right oblique angled prism of 130° 30′. It yields to mechanical division parallel only to the terminal plane. Before the blowpipe it melts with intumescence, emitting a phosphoric light.

It consists of silex 52.6, alumine 17.5, lime 9, water 18. It occurs usually in trap rocks, but is found in Chester, Mass. in mica slate, along with stilbite, chabasie and hexaedral crystals of carb. of lime.

SPECIES VI. HARMOTOME.

Color white, passing into grey, yellow, red and

brown: streak white: semi-transparent—translucent: brittle: nearly as hard as apatite: single crystals rectangular four-sided prisms, broad or compressed; but it frequently appears in double crystals, so intersecting each other that the broader planes of one crystal are perpendicular to the broader planes of the other. It melts with intumescence. Sp. gr. 2.39.

It consists of silex 49, barytes 18, alumine 16, water 15. Rare.

SPECIES VII. APOHYLLITE.

Color several shades of white, greyish, bluish or reddish: streak white: translucent—transparent: lustre vitreous: brittle. It yields easily to mechanical division parallel to the planes of a square prism: scratches fluor spar. It exfoliates and ultimately melts into a white blebby glass before the blowpipe. Sp. gr. 2.46.

It is composed of silex 51, lime 28, potash 4, water 17. In nitric acid it exfoliates or separates into flakes and becomes gelatinous. It occurs in trap rocks, in mineral veins, and along with the ores of copper and iron, and with pyroxene, carb. of lime, schaalstein, &c.

Var. 1. *Albin.* Occurs in cavities in lava, and consists of an aggregation of crystalline laminæ, which possess a laminated structure, but which are variously placed with regard to each other.

SPECIES VIII. NACRITE. *(SCALY TALC.)*

Color silvery-white or greenish-white: lustre pearly: friable and unctuous to the touch: adheres to the fingers, and gives out an argillaceous odor when breathed on. It is composed of a minute aggregation of scales, loosely cohering.

It consists of silex 50, alumine 26, potash 17, lime 15, oxide of iron 5.0.

SPECIES IX. CHLORITE.

Color various shades of green, as blackish-green, leek-green, apple-green, celandine-green, passing into greenish-grey, greenish-white, and greyish-white: streak corresponding to the color: translucent on the edges: laminæ flexible: may be scratched by the nail. Sp. gr. 2.71.

Var. 1. *Crystallized Chlorite.* Occurs in flat six-sided prisms, which are readily divisible into into thin laminæ parallel to their terminating planes: lustre pearly.

It occurs chiefly in the veins and cavities of primitive rocks.

2. *Compact Chlorite,* is amorphous, scarcely glimmering, and of an earthy texture. Before the blowpipe chlorite fuses into a black globule, with a dull surface.

It consists of silex 26, alumine 18.5, magnesia 8, oxide of iron 43, potash 2.

Appendix to Chlorite.

Green Earth. Color celandine-green, more or less deep, sometimes bluish or greyish-green, passing into olive or blackish-green: fracture dull, fine grained, earthy or uneven, or a little conchoidal: unctuous to the touch: yields to the nail. Before the blowpipe it is converted into a vesicular slag.

It consists of silex 52, magnesia 6, alumine 7, potash 7, oxide of iron 23, water 4.

It is found in amygdaloid, porphyry and basalt, filling cavities. It is employed as a pigment

When slightly calcined, it yields a durable reddish-brown for water colors.

SPECIES X. ARGILLITE. (*CLAY SLATE.*)

Color various shades of grey, blue or bluish, and sometimes greenish, and occasionally spotted: structure always slaty: lustre glimmering or dull: opake: yields to the knife: laminæ nearly vertical. It does not adhere to the tongue: fuses into a black slag. Sp. gr. 2.7.

It is composed of silex 25, alumine 16, magnesia 11.3, oxide of iron 4.11, water 7.6. It occurs in vast strata in primitive and transition mountains.

Var. 1. *Shining Argillite.* Color grey, bluish-grey, deep bluish-grey: layers usually undulated, and coated with a fine shining gloss.

2. *Roof Slate.* Lustre dull: splits into large thin and straight layers or plates.

3. *Shale.* It is softer than transition argillite; less solid; absorbs water, and readily falls to pieces in that liquid, but does not form a paste: structure slaty. It possesses the same color as common argillite, and scarcely differs from it. Sp. gr. 2.00.

4. *Bituminous Shale.* Color black or blackish-brown: structure slaty: yields easily to the knife. It is sufficiently impregnated with bitumen to burn with a flame more or less bright, which will sufficiently distinguish it from shining argillite. It is always connected with beds of coal.

5. *Novaculite.* Color yellowish-grey or green, with a tinge of red more or less deep. Its colors

are sometimes arranged in stripes. It is harder than common argillite, and more compact. It seems to be argillite intimately blended with siliceous matter, so that it is capable of wearing away the rounded surface of steel. It melts into a porous brown enamel. Sp. gr. 2.70.

It is composed of silex 71, alumine 15, oxide of iron 9, water 4. It is employed in the arts under the names of hone, oil-stone, Turkey-stone and whet-stone.

6. *Aluminous Slate.* Color bluish or greyish-black: structure slaty, either straight or curved. It reddens by the action of heat; and by exposure to the atmosphere, the softer varieties split and yield an efflorescence, having a saline and styptic taste. Sp. gr. 2.33—2.58.

It consists of silex 40, alumine 16, carbon 19, sulphur 28, water 10.7, sulphates of iron, lime and potash 1.5 of each, oxide of iron 6.4. It occurs in primitive, transition and secondary argillite.

7. *Graphic Slate.* Color bluish-black. It seems to be argillite intimately blended with plumbago so as to leave a black trace.

It consists of silex 64, alumine 11.25, carbon 11, oxide of iron 2.75, water 7.5. It is found in beds in common argillite.

SPECIES XI. WACKE.

Color greenish or yellowish-grey; sometimes mixed with brown or red, and sometimes passing into pale-green, blackish-green, dark-grey, greyish-black, or brownish-red: opake: fracture earthy, and sometimes a little conchoidal: dull: brittle, and may be cut by a knife: amorphous. It melts into a grey, opake, porous mass.

It consists of silex 28.0, alumine 23.0, lime 4.5, water 16.18, oxide of iron 26.0, carb. acid 2.32. Wacke is associated with transition and secondary rocks. It is often abundant in metals, as zinc, bismuth, magnetic iron, &c.

Var. Iron Clay. Color reddish and yellowish-brown : dull : brittle : fracture uneven or earthy, often vesicular.

It consists of silex 31.0, alumine 22, lime 4.5, water 15, oxide of iron 25. It occurs in beds associated with basalt and other secondary rocks.

SPECIES XII. KILLINITE.

Color greenish-grey, often tinged brown by oxide of iron : streak yellowish-white : faintly translucent : lustre faintly vitreous. It cleaves parallel to the sides of a rhombic prism of about 135°, and likewise in the direction of its shorter diagonal : fracture uneven : equals fluor in hardness. Sp. gr. 2.69.

It consists of silex 52.49, alumine 24.50, potash 5, oxide of iron 2.49, water 5.00. It melts with intumescence into a white enamel. It occurs in veins of granite in mica slate, along with spodumene, to which it is nearly allied.

SPECIES XIII. PYRALLOLITE.

Color white, sometimes greenish : translucent on the edges—opake : massive and crystallized in the form of an oblique four-sided prism of 94° 36′ and 85° 24′. It has the hardness of fluor spar. Before the blowpipe it first becomes blackish, but by continuing the heat it becomes white, and swells and melts on the edges into a white enamel. Its powder phosphoresces on hot iron with a bright bluish light. Sp. gr. 2.57.

It contains silex 56.6, magnesia 23.4, lime 5.6, alumine 3.6, bituminous matter and loss 6.4. It is found in limestone with pyroxene, scapolite and sphene.

SPECIES XIV. ASBESTUS.

Color some varieties of white, grey or green: structure always fibrous: its masses are composed of fibres more or less flexible, and sometimes elastic: lustre silky and pearly. It often has the softness of cotton, and agglutinates under the pestle. A single fibre exposed to the flame of a candle curls and melts into a globule. Sp. gr. 0.65—2.75.

There are several varieties which are known under distinct names.

Var 1. *Amianthus.* Occurs in long, slender flexible filaments, of a white, green or reddish color. Unctuous and soft to the touch.

It consists of silex 59, alumine 3, lime 9, magnesia 29. Usually found in serpentine. It may be manufactured into cloth.

2. *Common Asbestus.* Fibres stiff and scarcely flexible. Sp. gr. is nearly 3.00.

3. *Mountain Leather.* Fibres interwoven or interlaced. It occurs in flat pieces, having much the appearance of leather. When the pieces are thin, it is called *mountain paper.*

4. *Mountain Cork.* It hardly differs from the preceding. It has a meagre feel like cork, and swims on water.

5. *Mountain Wood.* It is hard and compact so as to resemble petrified wood. It breaks into long masses in the direction of the fibres: fuses into a

black slag. Sp. gr. 2. It seems often to pass into serpentine.

SPECIES XV. SERPENTINE.

Color green, yellowish-green, brown and nearly black: lustre slightly resinous or dull: translucent—opake: structure fine, granular or nearly compact. Before the blowpipe it hardens, and fuses with considerable difficulty on the edges. It is commonly divided into two varieties, *precious* and *common*. The former including the harder translucent kinds, with a splintery fracture; the latter the softer, and earthy kinds. Sp. gr. 2.56.

It is composed of silex 42.50, magnesia 38.63, alumine 1.00, water 15, oxides of iron, manganese and chrome 2.37. It forms mountain masses or beds, in primitive mountains, and in this country is connected with the hornblende rocks.

SPECIES XVI. TALC.

Color usually some shade of green, either dark or light: structure small or large foliated: foliæ flexible, not elastic. Before the blowpipe the laminæ separate, whiten, and their extremities melt into white or dark-colored enamel, according to the color of the specimen employed: lustre pearly: easily scratched by the nail. Sp. gr. 2.65.

It consists of silex 62.0, nagnesia 27, alumine 1.5, water 6.0, oxide of iron 3.5.

Sub Spe. *Steatite.* Color greyish-white, or greenish-white: structure compact: fracture splintery: difficult to break and easily cut with a knife. Before the blowpipe it hardens, and becomes converted into an enamel. Its surface is often like soap to the touch, and receives a polish from the *nail.* Sp. gr. 2.38—2.66.

It consists of silex 64, magnesia 22, alumine 3, water 5, iron 5. It occurs in beds in talco-micaceous and serpentine rocks.

Var. 1. *Potstone.* Color greenish-grey, and sometimes reddish: structure more compact than steatite, and more difficult to break: yields easily to the nail: unctuous to the touch, and has a pearly lustre. It is capable of being turned in a lathe and formed into culinary vessels.

2. *Crystallized Steatite.* Color yellowish-white: external surface often fibrous: cleavage none. It occurs in six and nine-sided prisms, with terminating pyramids at each extremity: solid angles often replaced: lustre pearly. This variety is sparingly found in serpentine, in Middlefield, Mass. in a horizontal vein. Between the roof and floor is interposed a stratum of mountain wood, two inches thick.

SPECIES XVII. DEWEYLITE.

Color white, yellowish-white and sometimes greenish: translucent. Becomes slightly opaline on being immersed in water, and breaks into numerous rounded fragments, or coarse grains: brittle: easily scraped and cut with a knife, the detached fragments being projected with considerable force. It is more or less traversed by cracks or seams in every direction, exhibiting a tendency to break into short columns: decrepitates strongly before the blowpipe: becomes snow-white, and fuses with difficulty into an enamel, without effervescence: structure generally compact, but sometimes slightly slaty: often exhibits in the interior mammillary and short stalactical concretions, which appear to be covered with the points of exceedingly minute crystals.

It is composed principally of silex and magnesia, with about 30 per cent of water. It is found in irregular seams or cavities in the brown serpentine of Middlefield, Mass. It has every appearance of having been formed by infiltration.

SPECIES XVIII. CEREOLITE.

This substance resembles wax, the softness of which it often possesses, and hence its name.

It has sometimes been confounded with steatite.

SECTION IV.

Specific gravity under 2.75. Hardness inferior to glass. Infusible.

SPECIES I. HYDRATE OF MAGNESIA.

Color white, occasionally with a tinge of green: semi-transparent: structure distinctly foliated, in one direction; or it occurs in plates which have a laminated structure, and are frequently disposed in a radiated form. Yields to the nail: lustre pearly. It dissolves entirely in the mineral acids without effervescence. Sp. gr. 2.33—2.63.

It consists of magnesia 70, water 30. It is found in the softer serpentines.

SPECIES II. MARMOLITE.

Color pale-green and grey: opake: massive. It has a cleavage in two directions oblique to each other: lustre pearly, and nearly metallic: brittle and easily cut with a knife: structure foliated: folia usually curved; becomes gelatinous in nitric acid.

It consists of magnesia 46, silex 36, lime 2, water 15, oxide of chrome 0.50. It occurs in serpentine, at Hoboken, N. J.

SPECIES III. MAGNESITE.

This species includes those minerals which are essentially composed of magnesia and silex, and sometimes the magnesia is united with carbonic acid. It possesses a great variety of external characters, and in fact embraces those minerals which cannot be referred to any other place, and which contain large portions of magnesia. By heat it diminishes in bulk but does not melt. It rarely effervesces although carbonic acid is often present. If moistened with diluted sulphuric acid, minute crystals of sulphate of magnesia appear in a few days. Its colors are white, grey, pale-yellow, and reddish. It does not form a paste with water. Sp. gr. 1.00—2.00.

Var. 1. *Meerschaum.* Color yellowish-white. It occurs in dull opake masses: unctuous to the touch, and of an earthy texture. It is often porous like tufa, and frequently swims on water. It yields to the nail, and adheres to the tongue.

It consists of silex 50, magnesia 17.25, carbonic acid 5, water 25. It occurs in compact limestone and serpentine.

2. *Argillo-Murite.* Powder dry to the touch. It swims on water till absorption takes place. Color greyish-white, clouded with yellow. Sp. gr. 0.36—1.37.

It consists of silex 55, magnesia 15, alumine 12, water 14, lime 3.

SPECIES IV. GIBBSITE. *(PURE ALUMINE.)*

Color yellowish or dirty white: cross fracture presents an imperfectly radiated structure: scratches calcareous spar: easily reduced to powder: lustre none: whitens by heat, but is infusible:

form irregularly stalactitic ; presenting an aggregation of elongated, tuberous masses. Often coats or invests the hæmatitic iron which is found with it. Sp. gr. 2.40.

It consists of alumine 64.8, water 34.7, and sometimes two or three per cent of lime.

It is found in a bed of brown hæmatite iron ore in Richmond, Mass. It resembles corralloidal arragonite.

Var. Pulverulent Gibbsite. Color snow-white, very soft and receives a polish by friction. It externally resembles the carbonate of magnesia of the shops. It seems to be only a variety of pure clay. It occurs in thin seams in the same mine with the preceding. I was informed that at one time a half bushel was thrown out of the workings. The mine where this singular mineral was found is now neglected.

SPECIES V. SILICIFEROUS HYDRATE OF ALUMINE.

Color white, or slightly tinged with yellow or green : soft : opake. When dry, the fracture is resinous, and it then absorbs about one eighth of its weight of water : it scarcely scratches calcareous spar : adheres to the tongue : by exposure to heat it becomes friable and loses about 40 per cent. It assumes a gelatinous appearance when acted on by acids.

It consists of alumine 44.5, silex 15, water 40.5. It was found in a lead mine in the Pyrenees.

Var. 1. Severite. Color white, without lustre, but slightly translucent : brittle : yields easily to the knife. It receives a high polish by friction ; adheres to the tongue, but has no argillaceous odor when breathed on. It remains unchanged by ex-

posure to heat, and is said to diffuse a scent like apples.

It consists of silex 50, alumine 22, water 26. It is found in a gravelly soil, in small masses, from 2 to 4 or 5 inches in diameter.

2. *Lenzinite.* It is divided into two varieties, the Opaline and Argillaceous.

(a) Opaline. Color milk-white. It occurs in small detached pieces, smooth to the touch, and slightly greasy: transparent: fracture conchoidal: sectile and moderately hard. Placed in water it divides with noise into a multitude of pieces.

It consists of silex 37.50, alumine 37.5, water 25.

(b) Argillaceous. Color snow-white: dull: fracture earthy: translucent, in minute pieces. Its parts cohere slightly, but it adheres strongly to the tongue. Placed in water it breaks down with much sediment. Exposed to a red heat, it becomes hard enough to scratch glass. Sp. gr. 1.80.

It consists of silex 39, alumine 35.5, water 25.

Var. 3. *Kollyrite.* This substance resembles white clay, from which water may be expelled by pressure, and it retains water so strongly as to require more than a month to dry even in small masses. It separates into columns on drying like starch.

It consists of alumine 45, silex 14, water 40.

4. *Allophane.* It occurs in colorless semi-transparent masses, with a vitreous lustre. Color blue, green and brown: brittle. It may occasionally be cleaved into rectangular prisms. Before the blowpipe it intumesces, but does not melt, and readily falls to powder. Sp. gr. 1.85.

It consists of alumine 32.20, silex 29.92, water 41.30, carb. of copper 3.05. It occurs in a bed of limestone, subordinate to grey wacke, in Thuringia.

SPECIES VI. CLAY STONE.

Color grey, often tinged with blue, yellow, and sometimes greenish : opake. It scarcely adheres to the tongue. In water it crumbles, but scarcely forms a paste. It may be cut with a knife. Sp. gr. 2.21.

It often resembles compact limestone or calcareous marl. It is compact and slaty. It is connected with all classes of rocks, but generally with the secondary.

SPECIES VII. CHLOROPHÆITE.

Color when recently broken varies from fine transparent yellowish-green, to a dull muddy-green. After a few hours exposure, it turns dark and shortly black. These changes take place while imbedded in the rock when near the surface. Soft and brittle. Sp. gr. 2.02.

It contains silex, alumine and iron. It occurs in small nodules from the size of a raddish seed to that of a pea and upwards, in amygdaloid.

SPECIES VIII. CLAY.

Under this denomination are included those earthy substances which may be formed into a paste, more or less ductile. They have a strong avidity for water, and hence usually adhere to the tongue or lip. They are essentially composed of silex and alumine, and are infusible, except when impure from the presence of carb. of lime or iron. The following varieties are usually noticed :

Var. 1. *Cimolite.* Color greyish-white, but

by exposure becomes reddish : texture a little slaty, and small scales may be separated, leaving a smooth resinous surface. It is rather difficult to break ; receives an impression from the nail, and affords a shining streak : adheres to the tongue : whitens, but does not fuse before the blowpipe. Sp. gr. 2.00.

It consists of silex 63.0, alumine 23.0, water 12, iron 1.25. It possesses the detergent property of fullers' earth.

2. *Potters' Clay.* It is diffusible in water, and when duly moistened becomes plastic, and forms a ductile, tenacious paste, called *long paste.* Sp. gr. 1.80.

It consists of silex 43, alumine 33.2, lime 3.5, water 18, iron 1.0.

Potters' clay is divided into pipe clay, variegated clay and loam.

1. *Pipe Clay.* Color pure white, sometimes yellowish or greyish-white. In a great heat it becomes perfectly white and is infusible.

2. *Variegated Clay.* Color different shades of white, yellow, blue and red, arranged in stripes, veins, &c.

3. *Loam.* It consists of potters' clay mingled with sand, oxide of iron, carb. of lime and decomposed vegetables. It is useful as a manure.

Var. 3. *Lithomarge.* Color white or grey, and sometimes tinged yellow : texture fine grain and even ; opake : fracture a little conchoidal : adheres to the tongue, and in water falls to powder, but does not form a paste : infusible if pure. Sp. gr. 2.4.

It consists of silex 52, alumine 36.5, water 14,

iron 2.7. It occurs in veins or thin seams in primitive rocks, particularly serpentine.

4. *Fullers' Earth.* Color whitish, with some shade of green: unctuous to the touch, and has but little adhesion to the tongue. In water it acquires some translucency and readily falls to powder, but is not much diffused.

It is often associated with oolite and marl. It is employed in the fulling of cloth.

SPECIES IX. PIMELITE.

Color apple-green or yellowish-green. It occurs in crusts of thin friable masses, or somewhat indurated and cracked: fracture earthy, without lustre: infusible.

It consists of silex 35.0, alumine 5.1, water 37.9, oxide of nickel 15.6, magnesia 1.3.

It is found in small cavities in the drusy quartz, traversing the serpentine, in Middlefield, Mass.

SPECIES X. NATIVE LIME.

It has the common characters of quick lime. It is found dissolved in the water of the ancient bath of Santa Gonda, in Tuscany. It is supposed to result from the action of volcanic fire on carb. of lime.

SECTION V.

Specific gravity above 2.75. *Hardness inferior to glass. Fusible.*

SPECIES I. MICA.

Color various shades of white, yellow, green, brown and black: thin laminæ flexible, elastic and transparent. It is easily divisible parallel to

the terminating planes: lustre shining or semi-metallic: yields easily to the knife on the broad planes, but its edges may scratch glass. It occurs crystallized in an oblique rhombic prism of 60° and 120°, which is the primary form. It melts usually with ease, and different colored varieties give different results before the blowpipe. Sp. gr. 2.94, of the darker varieties.

It consists of silex 46.10, alumine 31.10, potash 8.39, fluoric acid 1.12, oxide of iron 8, oxide of manganese 1.40.

It constitutes one of the essential ingredients of granite, gneiss, and mica slate.

SPECIES II. LEPIDOLITE.

Color pearl-grey, flesh or rose-red, or purple. It consists of small, flexible and elastic scales, which are sometimes hexagonal and translucent: yields to the nail, and is somewhat unctuous. Before the blowpipe it melts into a spongy translucent globule. Sp. gr. 2.85.

It consists of silex 49, alumine 33.61, potash 4, lithia 3.50, fluoric acid 3.44, oxide of manganese 1.40.

It occurs in granite with tourmaline, emerald, cleavelandite, mica, &c.

SPECIES III. SCHAALSTEIN.

Color white, greenish-white or grey. It appears in masses composed of thin laminæ, collected into large prismatic concretions. It has a cleavage parallel to the planes of a rhombic prism of 105° and 75°. Structure foliated: lustre pearly. When scraped with an iron point, it is phosphorescent in the dark, and when immersed in nitric acid it falls

into grains. It fuses with some ebullition into a white glass. Sp. gr. 2.86.

It consists of silex 50, lime 45, water 5. It is found in primitive rocks with colophonite, sahlite, &c.

SPECIES IV. PINITE.

Color grey, brown, blackish-brown, or greenish: opake: yields easily to the knife. It occurs in six-sided prisms, variously modified on the lateral edges. Some specimens have a distinct cleavage parallel to the terminating planes. It fuses with great difficulty into a dark colored enamel, but some varieties into a blebby whitish glass.

It consists of alumine 63, silex 25.9, oxide of iron 6.75. It occurs in granite and granitic veins in mica slate. It is found in masses of considerable size in mica slate, in Chester, Mass. along with quartz and mica.

SPECIES V. BILDSTEIN.

Color mostly greenish or yellowish-green, with veins of blue or brown: translucent on the edges: unctuous to the touch; and yields to the nail. Before the blowpipe it whitens and appears fused at the projecting part. It is always amorphous. Sp. gr. 2.80.

It consists of alumine 29, silex 56, lime 2, potash 7, water 5, iron 1.0.

It is cut into little grotesque figures, and is used for chimney ornaments. It resembles steatite, but contains alumine instead of magnesia.

SECTION VI.

Specific gravity above 2.75. *Hardness superior to glass. Infusible.*

SPECIES I. SAPPHIRE.

Colors numerous, as blue, red, yellow and grey, which are the most numerous: transparent—opake: it possesses double refraction: hardness inferior only to the diamond. Sp. gr. 3.71—4.28.

Sub Spe. 1. *Perfect Sapphire.* Colors blue, violet, red, yellow and green, which present many intermediate shades. It is also limpid: is easily broken, and its fracture is sometimes foliated, but usually conchoidal, splendent, and vitreous. Sp. gr. 3.91—4.32.

It is pure alumine; a little silex and iron being sometimes present. It is sometimes in rounded grains, but usually in crystals, whose primary form is a rhomb slightly acute; each of the plane angles at the summit being 86° 38'.

Perfect sapphire is divided according to the color which it presents, as the blue, violet and red sapphire.

Sapphire has been observed in gneiss, but is usually found in the sand of some rivers, and in alluvial earths. It is employed in jewellery, and in the holes of wheel pivots in astronomical clocks and watches. The red sapphire is the most esteemed, its value being sometimes equal to that of the diamond of the same size.

2. *Corundum.* Color greenish-grey, flesh or deep-red, yellowish-bluish, and even brown or blackish-brown. Its colors are not lively: structure foliated, and is divisible into rhomboidal frag

ments: amorphous and crystallized. Its more common form is a regular six-sided prism: translucent—opake. Sp. gr. 3.7—3.9.

Var. Emery. Color deep-grey, bluish-grey, or greyish-black. It is always amorphous: structure granular: lustre moderate. Sp. gr. 4.00.

Its powder is capable of wearing down all minerals.

SPECIES II. DIASPORE.

Color greenish-grey with a shining, pearly lustre: structure lamellar, straight or curved, and sometimes intersecting in various directions: thin laminæ transparent. It rarely occurs in crystals in the form of a doubly oblique prism. Exposed to the flame of a candle it crackles, and is dispersed in minute fragments, with brisk decrepitation. Sp. gr. 3.43.

It consists of alumine 80, water 17, iron 0.3.

Its geological situation is unknown.

SPECIES III. TURQUOISE.

Color greenish-blue, passing on the one hand into sky-blue, and on the other into apple-green. It is dull internally, but occasionally the lustre is waxy: opake. It is not quite so hard as quartz. With borax it melts into a limpid glass: fracture conchoidal—uneven. Sp. gr. 2.63—3.25.

It consists of alumine 73.0, water 18, oxide of copper 4.5, oxide of iron 4.0. It occurs in alluvial soil in reniform masses, from the size of a nut to that of a goose egg.

SPECIES IV. SPINELLE.

Color some shade of red, dark-blue, green or black: structure foliated parallel to the faces of the regular octaedron: transparent—opake: cross

fracture conchoidal. Sp. gr. 3.57—3.80. It is essentially composed of alumine and magnesia, with the oxide of iron and chromic acid as coloring matter. It is next to the sapphire in hardness.

Sub Spe. 1. *Ruby.* Color some shade of red, as carmine, scarlet, rose, violet, cherry or yellowish-red: lustre vitreous: transparent—opake. Sp. gr. 3.57—3.80.

It is composed of alumine 82.47, magnesia 8.75, chromic acid 6.18. It is usually found in the sand of certain rivers. When of a good color it is highly esteemed in jewellery.

2. *Ceylanite.* Color dark-blue, black or green, sometimes reddish or yellowish; less hard than the ruby, but easily scratches quartz: fracture conchoidal and shining. Sp. gr. 3.75—3.79.

It consists of alumine 68, magnesia 12, oxide of iron 16, silex 2. It occurs in carbonate of lime at Sparta, N. J. and in Orange co. N. Y. along, with Brucite, titaniferous iron, &c.

SPECIES V. FIBROLITE.

Color white or grey: structure fibrous; rather harder than quartz. It appears to cleave parallel to the sides of a right rhombic prism. It is traversed obliquely by cracks or seams: phosporescent by friction. Sp. gr. 3.2.

It consists of alumine 58, silex 38.

It is found in granite with corundum.

SPECIES VI. CYANITE.

Color blue: as prussian-blue, sky-blue, bluish-white, and sometimes bluish-green, pale-green or yellowish, and even white and reddish. It occurs in crystalline masses, or single crystals: primary

form a doubly oblique prism : structure distinctly foliated parallel to the broader planes, which have a much stronger lustre than those which are narrow : translucent: it is scarcely harder than glass, though the edges of the laminæ will scratch it. Sp. gr. 3.47—3.70.

It consists of alumine 55.5, silex 43, oxide of iron 0.5.

Var. Rhætizite. Color reddish-white, pale-yellow, or greyish-white. Its masses are composed of aggregated fibres, either straight or diverging: they are traversed obliquely by cracks or seams. Sp. gr. 3.10.

Cyanite is usually found in mica slate, and in granitic veins traversing mica slate.

SPECIES VII. STAUROTIDE.

Color reddish-brown, often dark and even blackish-brown. It is always crystallized, and frequently appears under the form of a right rhombic prism of 129° 20′ and 50° 40′. It feebly scratches quartz : structure foliated parallel to the axis of the prism : lustre resinous : it equals quartz in hardness : crystals often intersect each other at particular angles. Sp. gr. 3.30.

It consists of alumine 52.25, silex 27, oxide of iron 18, oxide of manganese 0.25. It belongs principally to mica slate, and is associated with garnet which it often resembles.

SPECIES VIII. BUCHOLZITE.

Color white and black, appearing in spots : in thin fragments, translucent : not so hard as quartz : structure fibrous but indistinct in the white spots.

It consists of alumine 50, silex 46.0, potash 1.5, oxide of iron 2.5. It has been found in aluminous slate.

SPECIES IX. ANDALUSITE.

Color grey, flesh-red, brown and violet: slightly translucent at the edges: structure foliated parallel to the sides of a slightly rhombic prism: scratches spinelle. Sp. gr. 3.20.

It is found only in primitive rocks.

It contains alumine 52, silex 38, potash 8, iron 2. It has some resemblance to feldspar.

SPECIES X. LAZULITE.

Color light indigo-blue, but darker than smalt-blue: translucent on the edges—opake: structure foliated and is divisible into prisms slightly rhombic: lustre vitreous—shining: cross fracture uneven: brittle: powder bluish-white: becomes light-grey and earthy before the blowpipe, and with borax it forms a yellowish glass.

It contains alumine 66.0, silex 10, magnesia 18.0, lime 2, oxide of iron 2.5.

It is found in mica slate and argillite.

Sub Spe. *Blue Spar.* Color pale smalt-blue, sky-blue and bluish-white. It is divisible into nearly rectangular four-sided prisms: less hard than quartz: whitens and forms a frit before the blowpipe. Sp. gr. 3.06.

It contains alumine 71, silex 14, magnesia 5, lime 3, water 5, potash 0.5, oxide of iron 0.75.

SPECIES XI. CHRYSOBERYL.

Color usually yellowish-green: translucent—transparent: scratches the spinelle: it often shows an opalescing bluish-white light internally: occurs in grains, or in crystals, whose primary form is a right rectangular prism. Sp. gr. 3.8.

It consists of alumine 71.5, silex 18, lime 6, oxide of iron 1.5. It contains glycine.

Chrysoberyl is considerably employed in jewellery.

It is found in coarse grained granite, along with garnet, tourmaline, emerald, &c.

SPECIES XII. TOPAZ.

Color various shades of yellow, green, blue, lilac and red. It is likewise limpid: structure lamellar perpendicular to the axis of the prism: striated longitudinally: primary form a right rhombic prism of 124° 22′ and 55° 38′. Scratches quartz. Sp. gr. 3.5.

It consists of alumine 50, silex 29, fluoric acid 19. It is found exclusively in the oldest primitive rocks.

When of a good color and free from flaws it is employed in jewellery.

Var. 1. *Pyrophysalite.* It occurs in small, roundish or prismatic masses, either transparent or opake; having a greenish-white or pale bluish-green color: structure in one direction distinctly foliated, with a strong lustre: fracture uneven or conchoidal. Its hardness differs but little from the topaz: infusible. Sp. gr. 3.45.

It contains alumine 57.7, silex 34.4, fluoric acid 7.8.

Sub Spe. *Pycnite.* Color usually yellowish-white, straw-yellow, greenish or reddish-white. It occurs nearly regular in hexaedral prisms, frequently long and longitudinally striated: structure parallel to the bases of the prism imperfectly foliated: lustre glistening, and somewhat resinous: slightly scratches quartz: several prisms often applied to each other laterally, and exhibit transverse rents. Sp. gr. 3.5.

It is composed of alumine 57.0, silex 38.4, fluoric acid 8.8. It is found in mica slate, steatite, and likewise imbedded in an aggregate of quartz, tin, wolfram and molybdena.

SPECIES XIII. BRUCITE. *(CHONDRODITE.)*

Color wine-yellow or reddish-brown: translucent. It occurs in grains or masses which present some appearance of a regular form and crossed by rents which are nearly parallel: it has the hardness of feldspar. Before the blowpipe it becomes milk-white; with borax it fuses completely into a transparent glass, tinged by iron. Sp. gr. 3.2.

It is composed of alumine, silex, lime, magnesia and fluoric acid. It is found in primitive limestone, associated with spinelle.

SPECIES XIV. GAHNITE. *(AUTOMALITE.)*

Color dark bluish-green, mountain-green, or greenish-black: structure foliated parallel to all the faces of the regular octaedron: lustre shining or resinous: scratches quartz, but is less hard than the spinelle: with borax it gives a green glass while hot, which becomes colorless when cold. Sp. gr. 4.2—4.6.

It is composed of alumine 60, oxide of zinc 24. 25, oxide of iron 9.25, silex 4.75. It has been found in talcose rocks.

SPECIES XV. ZIRCON.

It presents two varieties.

Var. 1. *Common Zircon.* Colors numerous. It presents several shades of grey and green, and is sometimes yellowish, bluish, red, brown, reddish-brown, and is even white and limpid: transparent—opake. It occurs in rounded grains

crystals, whose primary form is an octaedron of 82° 50' : surface of the crystals often presents an oily aspect : harder than quartz : it possesses double refraction : loses the color before the blow-pipe.

It consists of zirconia 69, silex 26.5, oxide of iron 1.00.

2. *Hyacinth.* Color hyacinth-red, and passes into reddish-yellow, brownish-red or reddish-grey : translucent—transparent : natural joints more distinct than in common zircon. Before the blowpipe it loses its color but is transparent.

It is composed of zirconia 70, silex 25, oxide of iron 0.5. It strongly resembles garnet. It is found in the sand of rivers and in primtive rocks. Both varieties are employed in jewellery even when discolored by heat.

SPECIES XVI. CHRYSOLITE.

Color yellow, sometimes tinged brown or green : translucent : it possesses double refraction : less hard than quartz. It has cleavages parallel to the sides of a right prism with rectangular bases, yielding by measurement 90°. Lustre vitreous : cross fracture conchoidal. Sp. gr. 3.4.

It consists of magnesia 50.5, silex 38, oxide of iron 9.5. Its geological situation is but little known, but it is said to be found in serpentine. It is sometimes employed in jewellery, but is not much esteemed.

Var. 1. *Olivine.* Prevailing color olive-green. It presents itself in lamellar masses and in grains, but never in crystals : translucent. It loses its color in nitric acid, and melts with borax into a dark-green bead. Sp. gr. 3.24.

It consists of silex 50.0, magnesia 38.5, lime 0. 25, iron 12. It occurs in basalt and lavas, and is accompanied by pyroxene.

2. *Meteoric Olivine.* Semi-transparent and yellowish : fracture conchoidal.

It is composed of silex 41.0, magnesia 38.5, oxide of iron 18. It is found disseminated in meteoric iron.

SPECIES XVII. ANTHOPHYLLITE.

Color between yellowish-grey, clove-brown and greenish-black : streak white : translucent, and sometimes only on the edges : brittle : it slightly scratches glass : lustre pearly : fracture uneven : Its masses often composed of acicular prisms, either diverging or promiscuous : cleavage parallel to the sides of a four-sided prism of 124° 30′, and both diagonals, but more distinct in the direction of the long diagonal. Sp. gr. 3.12.

It consists of silex 56, alumine 13, magnesia 14, lime 3, oxide of iron and manganese 9, water 1.43. It is found in mica slate, and in a dark colored serpentine in Blandford, Mass.

SPECIES XVIII. CHIASTOLITE.

This mineral has only been met with in apparently rectangular prisms, composed of two distinct substances. The exterior is greyish or greenish-white, sufficiently hard to scratch glass ; the interior is bluish-black or black, and is apparently of the same nature as the surrounding rock, and is soft. Sometimes the internal prism communicates by a black line to the external coating, or to four black prisms, so that the chiastolite occasionally consists of five black prisms, imbedded in a greyish substance. Infusible.

It is found imbedded in a micaceous or argillaceous rock.

SPECIES XIX. SILLIMANITE.

Color dark-grey, passing into clove-brown : translucent on the edges : hardness superior to quartz or even to topaz : cleavage parallel to the longer diagonal of a prism of 106° 30′ ; the inclination of the base to the axis being 113°. Fracture uneven and splintery : surface often rounded, the crystals themselves bent : lustre on the cleavage planes brilliant : brittle and easily reduced to powder. Sp. gr. 3.41.

It consists of silex 42.66, alumine 54.11, oxide of iron 1.99, water 0.51. It seems to pass into a substance resembling fibrolite.

SPECIES XX. FORSTERITE.

Colorless : brilliant and transparent : scratches quartz. It occurs in prismatic crystals, having nearly the same measurements as corundum : cleavage distinct, perpendicular to the axis.

It is said to consist of silex and magnesia. It is found associated with spinelle and green pyroxene, near Vesuvius.

SECTION VII.

Specific gravity above 2.75. *Hardness superior to glass. Fusible.*

SPECIES I. AXINITE.

Color brown, violet-grey, or whitish, and sometimes green : translucent—transparent : lustre somewhat shining and vitreous : hardness between feldspar and quartz ; it rarely occurs massive, often in flattish crystals, whose edges are remark-

ably sharp. Before the blowpipe it easily melts with ebullition into a bottle-green glass, which becomes grey by continuing the heat.

It contains silex 44, alumine 18, lime 19, iron 14, manganese 4. It is found in veins and fissures which traverse primitive rocks, and is associated with epidote, chlorite, feldspar and asbestus.

SPECIES II. GARNET.

Color brown and red of different shades, and sometimes yellow, green and black: transparent—opake: lustre resinous or vitreous: fracture uneven passing into conchoidal: melts easily into a black dull enamel: often magnetic: scratches quartz: usually in crystals whose primary form is a dodecaedron with rhombic faces; the inclination of any two contiguous faces is 120°. Sp. gr. 3.55—4.35.

Several varieties are noticed:

Var. 1. *Precious Garnet.* Color red, of different shades: translucent—transparent: lustre vitreous: fracture conchoidal. Sp. gr. 4.08—4.35.

It consists of silex 36, alumine 22, lime 3, oxide of iron 41. It is found in mica slate, chlorite slate, gneiss and granite.

2. *Pyrope.* Color red with a tinge of orange-yellow: usually transparent with a splendent vitreous lustre, and conchoidal fracture. Sp. gr. 3.7—3.9.

3. *Topazolite.* Color topaz-yellow, and sometimes nearly olive-green.

It contains silex 37, alumine 2, lime 29, glucine 4, iron 25, manganese 2.

4. *Succinite.* Color amber-yellow: almost transparent. It is found in serpentine.

5. *Melanite.* Color velvet-black: opake: lustre shining and resinous. Sp. gr. 3.61.

It contains silex 35.5, alumine 6, lime 32.5, oxide of iron 25.25.

6. *Pyreneite.* Color greyish-black: opake. Sp. gr. only 2.53. Before the blowpipe it melts into a vesicular enamel.

It is found in primitive limestone near the Pyrenees.

7. *Grossular.* Color asparagus, olive, or mountain-green. It is found in the form of a trapezoedron or dodecaedron, with truncated edges. Sp. gr. 3.3—3.6.

It contains silex 44.0, alumine 8.5, lime 33, oxide of iron 12. It is found in an argillaceous rock with idocrase.

8. *Allochroite.* Color yellowish or greenish or brownish-grey: amorphous, with slaty structure: fracture uneven. Sp. gr. 3.5—3.7.

It contains silex 37, alumine 5, lime 30, oxide of iron 18.5, oxide of manganese 6.25.

9. *Colophonite.* Color usually orange-yellow, reddish, yellowish-brown, brownish-black or oil-green. Distinguished by its glossy, resinous fracture and iridescent colors. Sp. gr. 4.

Sub Spe. *Manganesian Garnet.* Color deep hyacinth or brownish-red: translucent at the edges: fuses with borax and a little nitre into a violet globule.

It is composed of silex 35, alumine 14, oxide of manganese 35, oxide of iron 14.

The precious garnet and pyrope are employed in jewellery.

SPECIES III. APLOME.

Color deep-brown, or orange-brown, some-

times yellowish-green: occurs in dodecaedrons, striated parallel to the shorter diagonals; and is usually truncated with solid angles: primary form a cube. Sp. gr. 3.44.

It consists of silex 40, alumine 20, lime 14, oxide of iron 14.5, oxide of manganese 2, silex 2. It has a strong resemblance to the garnet.

SPECIES IV. EPIDOTE.

Color commonly some shade of green, also grey, yellow and brown: translucent—opake. Before the blowpipe it melts into a dark brown scoria, which by increasing the heat becomes a dark enamel. It appears in lamellar, granular and compact masses. It is less hard than quartz. It also occurs in crystals: primary form a right oblique angled prism of 115° 30′ and 64° 30′. Sp. gr. 3.45.

It consists of silex 37, alumine 21, lime 15, oxide of iron 24, oxide of manganese 1.5. It is found in primitive rocks. It is characterized by its yellowish-green color.

Var. 1. *Arenaceous Epidote.* Occurs in grains of various sizes of a yellowish and green color, somewhat vitreous in their appearance.

2. *Manganesian Epidote.* Color violet or reddish-brown. It occurs in small prismatic crystals which are generally in groups, sometimes imbedded in asbestus. It is found in gneiss, argillite, sienite, greenstone, &c. It contains about 12 per cent of the oxide of manganese.

SPECIES V. ZOISITE.

Color grey, yellowish-grey, or brownish: lustre pearly or nearly dull: it occurs massive and crystallized; it cleaves parallel to the sides and both diagonals of a right rhombic prism of 120° and

60°, but not with brilliant surfaces. Crystals rarely perfect, owing to the deep longitudinal striæ; often appear compressed, and sometimes the obtuse angles are rounded. It fuses on the outer edges into a yellowish transparent glass, but finally into a vitreous scoria.

It consists of silex 45, alumine 29, lime 21, oxide of iron 2.4.

SPECIES VI. CINNAMON STONE.

Color hyacinth-red, yellowish-brown, honey-yellow, and brownish-orange; if held near the eye it appears yellow: translucent: fracture imperfectly conchoidal, with a vitreous lustre: scratches quartz: yields to mechanical division parallel to the planes of a rhombic dodecaedron. It melts with ebullition into a reddish-brown or greenish glass. Sp. gr. 3.6.

It is composed of silex 38.8, lime 31.21, alumine 21.2, oxide of iron 6.5. It resembles the garnet. It is found in the sand of rivers in Ceylon. The following is considered a variety of cinnamon stone.

Var. Romanzovit. Color brown, brownish-black, and black: is less hard than quartz: it cleaves parallel to the faces of a rhombic dodecaedron: fracture conchoidal: lustre resinous or greasy. It melts without ebullition into a glass, of the same color as the mineral. Sp. gr. 3.61.

It consists of silex 41.24, alumine 24.08, lime 24.76, oxide of iron 7.02. It has been found only in Finland.

SPECIES VII. IDOCRASE.

Color brownish or yellowish-green, sometimes orange, rarely black: massive and crystallized:

primary form a right square prism, and is divisible parallel to both diagonals. Differs but little from quartz in hardness: lustre vitreous. It possesses double refraction: fuses with ebullition into a yellowish translucent glass. Sp. gr. 3.08—3.44.

It is composed of silex 35.50, alumine 33, lime 22.25, oxide of iron 7.50. Often resembles garnet and sometimes epidote. It occurs in primitive rocks, associated with hornblende, garnet, epidote, carbonate of lime, &c.

SPECIES VIII. PREHNITE.

Color varies from apple-green to greenish-white or nearly white: lustre moderate, and somewhat pearly: translucent: it always appears to result from crystallization: primary form a right rhombic prism of 100° and 80°. Fuses into a white frothy glass. Sp. gr. 2.92.

Var. 1. *Fibrous Prehnite.* It occurs in globular, radiated masses, sometimes nearly compact.

Prehnite is composed of silex 48.8, alumine 30.33, lime 18.33, oxide of iron 5.66, water 1.83.

It is mostly found in greenstone and amygdaloid, or in hornblende rocks.

SPECIES IX. SPODUMENE.

Color greyish-white, light-green or greenish-white: translucent at the edges: lustre feeble or pearly: structure foliated parallel to the sides and shorter diagonal of a rhombic prism of 100° and 80°: cross fracture uneven. Before the blowpipe it fuses with intumescence into a colorless glass. Sp. gr. 3.19.

It is composed of silex 66.4, alumine 25.3, lithia 8.85, oxide of iron 1.45. It is found in granite.

SPECIES X. YENITE.

Color black, brownish or greyish-black, and sometimes greenish-black. It occurs amorphous, acicular and crystallized in rhombic prisms of 111° 30′ and 68° 30′: cleaves parallel to the longer diagonal. It fuses readily into a black globule, which attracts the magnet. Sp. gr. 3.8.

It is composed of silex 29.27, lime 13.77, alumine 0.61, oxide of iron 57.5. It seems to be an ore of iron. It belongs to primitive rocks, and is associated with hornblende and epidote, which it closely resembles.

SPECIES XI. HORNBLENDE.

Color dark bottle-green or brownish-green or black: powder greenish-grey: lustre shining: translucent on the edges—opake: very tough: cleavage parallel to the planes of a rhombic prism of 124° 30′ and 55° 30′, but not parallel to the terminal planes. It readily fuses with intumescence into a brownish-grey opake glass. Sp. gr. 3.6.

It is composed of silex 42, alumine 12, lime 11, magnesia 2, oxide of iron 30. Hornblende includes the following varieties or sub-species:

Var. 1. *Basaltic Hornblende.* Color pure black: always in distinct crystals: it is very often found in basalt; hence its name.

2. *Lamellar Hornblende.* It is composed of lamellæ: fracture foliated: folia inclined or interlaced.

3. *Fibrous Hornblende.* It is composed of acicular crystals, broad or narrow, parallel or interlaced.

4. *Carinthin.* Color black or greenish-black: translucent at the edges: structure foliated: lus-

tre vitreous: rather soft and difficult to fuse. It has the cleavage of hornblende.

Sub Spe. 1. *Actynolite.* Color lively green: translucent: melts into a grey enamel, tinged with yellow or green. Occurs in long incomplete prismatic crystals, variously aggregated. Easily broken in a transverse direction. Sp. gr. 2.99—3.30.

It consists of silex 50, alumine 0.75, lime 9.75, magnesia 19.25, oxide of iron 11.0, chrome 3, water 5.

Var. 1. *Pargasite.* Occurs in crystallized rounded grains, imbedded in carbonate of lime: translucent and green.

2. *Asbestiform Actynolite.* Color green or greenish-grey, both massive and in capillary crystals, which are elastic; and disposed in wedge-shaped masses or in radii: opake, or slightly translucent on the edges: melts into a yellowish-brown opake glass.

Hornblende occurs in mountain masses: actynolite occurs in veins in hornblende and talcose rocks.

Sub Spe. 2. *Tremolite.* Color white, sometimes greenish: it cleaves with brilliant surfaces parallel to the sides of a rhombic prism of the same measurement as hornblende: semi-transparent or translucent: crystals striated longitudinally and often flat or bladed: terminations imperfect and often traversed by fissures oblique to the axis of the prism: brittle: phosphoresces by heat and friction. It fuses into an opake grey-white mass. Sp. gr. 2.93.

It consists of silex 50, lime 18, magnesia 25, carbonic acid and water 5. It occurs granular and fibrous.

Var. Asbestiform Tremolite. It occurs in masses, consisting of fasciculated groups of minute diverging fibres, which are sometimes so intimately associated as to become massive: lustre pearly or silky. It has the soft feel of asbestus: phosphorescent by friction. Abundant at Sheffield, Mass. in dolomite.

Hornblende, actynolite and tremolite, differ but little in their essential constituents; and they pass into each other by imperceptible shades.

SPECIES XII. BASALT.

Color usually greyish-black: amorphous: opake: streak light: fracture uneven, or fine splintery: dull, tough and sonorous when struck: less hard than quartz. It easily fuses into a black glass. Sp. gr. 3.00.

It consists of silex about 44.5, alumine 16.75, lime 9, magnesia 2.6, soda 2, oxide of iron 20. It occurs in large masses under a columnar, tabular or globular form.

SPECIES XIII. HYPERSTHENE.

Color dark-brown or greenish-black: structure lamellar, parallel to the sides of a rhombic prism of 87° and 93′. When fractured it exhibits reflections which are strongly metallic, sometimes greenish and sometimes copper-red. In thin laminæ translucent: powder dark-grey: fuses easily into a greyish-green glass. Sp. gr. 3.40.

It is composed of silex 54.25, alumine 2.25, magnesia 14, oxide of iron 24.5, lime 1.5.

It is found associated with hornblende and opalescent feldspar.

SPECIES XIV. BRONZITE.

Color brown, usually with a shade of yellow

and sometimes bronze-yellow : powder nearly white : opake or translucent in thin fragments : cleavage parallel to the planes and both diagonals of a rhombic prism of 93° 30', with indications of another cleavage perpendicular to the axis. Sp. gr. 3.3.

It consists of silex 60, magnesia 27.5, oxide of iron 10.5. It is found in masses in serpentine.

SPECIES XV. METALLOIDAL DIALLAGE.

Color bottle-green, metallic-grey, or almost silver-white, or brownish-green. When held in certain directions, has a shining, metallic lustre, which rapidly appears and disappears when turned : opake : fuses into a blackish enamel. Sp. gr. 3.

It is composed of silex 41, alumine 3, lime 1, magnesia 29, oxide of iron 14, water 10. It is found in serpentine and sometimes in greenstone.

SPECIES XVI. GREEN DIALLAGE.

Color emerald-green or grass-green : translucent in thin fragments : it exhibits a structure both lamellar and fibrous : slightly scratches glass : it is easily divisible into laminæ having a pearly lustre : cleavage parallel to a rhombic prism : it fuses into a greyish-green enamel. Sp. gr. 3.2.

It is composed of silex 50, alumine 21, lime 18, magnesia 3, and a trace of oxide of chrome. It belongs to the Amphibole according to Phillips. It is found near Westfield, Mass. in a dark colored serpentine.

SPECIES XVII. PYROXENE. *(AUGITE.)*

Color green, brown, or brownish-black, with or without lustre. It cleaves parallel to the sides of

a rhombic prism of 87° 5′ and 92° 55′. Before the blowpipe it fuses into a dark colored glass. Sp. gr. 3.15—3.57.

It is composed of silex 54.86, lime 23.57, magnesia 16, protoxide of iron 4.44. It is met with in volcanic rocks, and likewise in primitive, associated with carb. of lime, mica, garnet, actynolite, &c. The following substances are varieties of pyroxene :

Var. 1. *Diopside.* Color green, of various shades : translucent—transparent : crystals mostly striated longitudinally : they have the structure and measurement of pyroxene. Before the blowpipe it fuses into a semi-transparent mass : scratches glass with difficulty. It is found in serpentine.

2. *Fassaite.* Color dingy-green : yields readily to mechanical division, parallel to a prism of the same measurement as pyroxene.

3. *Sahlite.* Color greenish-grey : occurs massive and crystallized. It allows of mechanical division parallel to the oblique terminal planes.

4. *Baikalite.* Color grey or greenish-white : structure the same as sahlite. It is found in granite with carb. of lime.

5. *Euchysiderit.* It is considered as pyroxene, into which iron enters in a large proportion. The crystals have brilliant surfaces, but are without regular terminations.

6. *Coccolite.* Color various shades of green, from light to very dark ; likewise red and black : always in irregular grains, with a lamellar structure, and only slightly coherent. It passes into sahlite. Sp. gr. 3.3.

It is found in primitive rocks, with carb. of lime, titanium, &c.

7. *Jeffersonite.* Color dark olive-green, passing into brown : opake : scratches glass with difficulty : cleavage parallel to the terminal and lateral planes and both diagonals of an oblique rhombic prism of about 87° and 93°. Sp. gr. 3.55.

It is composed of silex 56, lime 15.7, black oxide of manganese 13.58, peroxide of iron 10. It is found imbedded in franklinite and garnet.

SPECIES XVIII. SCHORL.

Color black, indigo-blue, violet, and sometimes brown : occurs most frequently in long prismatic crystals, more or less regular, and almost always striated longitudinally. These prisms present six, nine or twelve sides, and are variously terminated. Primary form an obtuse rhomboid of 133° 26′ and 46° 34′. Very brittle : nearly as hard as quartz : fracture conchoidal : lustre vitreous or resinous. It easily melts with ebullition into a vesicular enamel. Positively electric by friction. Sp. gr. 3—3.36.

It is composed of silex 36.75, alumine 34.5, potash 6, oxide of iron 21.

Var. 1. *Common Schorl.* Color velvet-black. It is frequently composed of long cylindrical or acicular crystals, either parallel or diverging.

2. *Tourmaline.* Color green, blue, brown, and sometimes limpid : transparent—opake.—When viewed in a direction perpendicular to the axis, the crystal is frequently translucent, but in an opposite direction, opake.

(a) Green Tourmaline. Color varies from leek-green to olive-green : striated longitudinally,

and traversed by seams of quartz oblique to the axis of the prism. Sp. gr. 3.

It occurs in granite traversing mica slate.

(b) Yellow Tourmaline. Color honey-yellow or orange.

(c) White Tourmaline. Color white, sometimes partly white and partly black. It occurs in dolomite.

(d) Indicolite. Color dark or light indigo-blue, and sometimes it appears with a tinge of green : translucent when viewed obliquely to the axis of the prism.

Tourmaline consists of silex 42.59, alumine 34.32, magnesia 8.47, potash and soda 2.42, boracic acid 0.60, oxide of iron 5.22. The blue variety is rare in Europe.

Sub Spe. *Rubellite.* Color red, of various shades, as crimson, pink, rose, violet, and even appears with a tinge of green : translucent—transparent : it slightly scratches quartz. Before the blowpipe it is fused with great difficulty into a grey enamel. Its crystals are sometimes cylindrical or acicular, and aggregated in groups. Sp. gr. 3.07.

It consists of silex 42, alumine 40, soda 10, oxide of manganese and iron 7. It is found usually in granitic veins, traversing gneiss or mica slate, accompanying the green and blue tourmalines. A single specimen of rubellite in the British museum, is valued at 500*l.*

SPECIES XIX. HAUYNE.

Color when opake indigo-blue ; when translucent, blue or bluish-green. It occurs in small crystals or crystalline grains, which scratch quartz,

but are very brittle : structure imperfectly foliated, with a conchoidal fracture. Before the blowpipe it fuses into a white vesicular globule, nearly opake. Its powder forms a translucent jelly in acids. Sp. gr. 3.2.

It is composed of silex 35.5, alumine 18.9, potash 15.4, sulphuric acid 12.6, lime 11.8, oxide of iron 1.2. Primary form a rhombic dodecaedron. It is found in rocks ejected from volcanoes, along with sahlite, feldspar, mica, idocrase, and meionite.

SPECIES XX. GEHLENITE.

Color different shades of grey, and none of them bright : lustre vitreous, inclining to resinous : opake, but sometimes faintly translucent at the edges : brittle : scratches glass : it fuses with difficulty into a brownish-yellow glass. It gelatinizes in hot muriatic acid.

It consists of alumine 24.80, silex 29.64, lime 35.30, oxide of iron 6.56, water 3.30. It is found in a gangue of calc. spar.

SPECIES XXI. KARPHOLITE.

Color usually an intense straw-yellow, but sometimes wax-yellow, and sometimes white. In detached fibres translucent : very brittle : structure fibrous, and usually divergent : lustre pearly. Sp. gr. 2.93.

It contains silex 37.5, alumine 26.6, water 11.4, oxide of manganese 18.3, iron 6.3. It is sometimes connected with mica.

SPECIES XXII. GADOLINITE.

Color velvet-black, brownish, or greenish-black : faintly translucent at the edges—opake : fracture

conchoidal: lustre resinous: usually amorphous, but sometimes crystallized: primary form an oblique rhombic prism of about 96° 30′. It fuses with difficulty in thin fragments into a slag. When heated slowly most of its varieties appear as if burning. Sp. gr. 4.20.

It consists of yttria 45, silex 28, oxide of cerium 16.69, oxide of iron 10.26. It resembles massive chromate of iron. It is found associated with oxide of columbium, and also in a coarse grained granite, traversing gneiss.

SPECIES XXIII. IOLITE.

Color violet-blue, often with a shade of purple or black: powder bluish-grey: when viewed in a direction parallel to the axis of the primitive form, its color is dark indigo-blue; but when viewed perpendicular to the axis, its color is brownish or greyish-yellow: translucent in various degrees: scratches glass easily and sometimes quartz: lustre vitreous: it is fused with difficulty into a pale greenish-grey enamel. Sp. gr. 2.56—2.71.

It contains silex 42.6, alumine 34.4, magnesia 5.8, lime 1.7, oxide of iron 15, manganese 1.7. It occurs in primitive rocks, associated with quartz, feldspar, pyritous copper, tourmaline, &c.

Var. 1. *Peliom.* It occurs in blue regular six-sided prisms, truncated on the edges and angles: fracture conchoidal: lustre vitreous. Sp. gr. 2.71.

2. *Steinheilite.* Color smalt-blue, with a slight tinge of red, and is more or less translucent: usually amorphous; with a splintery fracture and vitreous lustre: it is slightly scratched by rock crystal. Sp. gr. 2.69.

It has been considered a blue quartz.

SPECIES XXIV. LAPIS LAZULI.

Color various shades of azure-blue : streak blue, paler than the color : translucent on the edges : it has an imperfect cleavage parallel to the planes of a dodecaedron : fracture imperfectly conchoidal, uneven : surface even, though rough : it melts with difficulty into a glassy globule, which at first has a bluish tinge but soon becomes white. Sp. gr. 2.40—2.95.

It is composed of silex 49.00, magnesia 2, alumine 11, lime 16, potash and soda 8, oxide of iron 4, sulphuric acid 2. Nothing is known of its geological associations.

Ultra marine is obtained from it. It is likewise cut in various ornamental works, as ring stones, snuff boxes, &c.

SPECIES XXV. EUCLASE.

Color greenish-white, apple or mountain-green, bluish-green or dark sky-blue. It has only been seen in crystals, whose form is an oblique angled prism, variously modified by truncations on the lateral edges : sides of the prism often exhibit deep longitudinal striæ : very brittle : lustre strongly vitreous. Before the blowpipe it becomes opake, and melts into a white enamel. Sp. gr. 3.10.

It consists of silex 42.2, alumine 30.6, glucine 21.8, oxide of iron 2.2. Its associations with other minerals are not known.

SPECIES XXVI. JADE.

The general characters of jade are a great hardness, remarkable tenacity, a color more or less green, with an oily aspect when polished. It includes three sub-species.

Sub Spe. 1. *Nephrite.* Color varies from leek-green to greenish-white. When polished the surface appears oily. It equals quartz in hardness: very tough: fuses with ebullition into a white semi-transparent globule. Sp.gr. 2.95—3.04.

It consists of silex 53.75, lime 12.75, soda 10.75, potash 8.50, alumine 1.50, oxide of iron 5, oxide of manganese 2, water 2.25.

2. *Saussurite.* Color deep-green, sometimes greyish-green, and often with a tinge of blue: very tough: aspect, when polished, less oily than nephrite: translucent. It melts before the blow-pipe into a greenish-white glass. Sp. gr. 3.35.

It is composed of silex 44.0, alumine 30, soda 6, lime 4, oxide of iron 12.5. It is found in solid pieces, and disseminated in serpentine.

3. *Axestone.* Color varies from leek-green to olive-green and greenish-grey. Its hardness is less than nephrite: more brittle, and often falls into tabular fragments: translucent. Sp. gr. 3.0.

It melts into a black globule without intumescence. Is allied to serpentine; and is employed by the South Sea islanders for making axes, hatchets, &c.

APPENDIX.

Containing Minerals which have not been analyzed, or of which but little is known.

ACMITE.

Color brownish-black: streak pale yellowish-grey: very thin edges translucent, shewing a fine yellowish tint: brittle: hardness equals glass: fracture imperfectly conchoidal: surface irregularly streaked in a longitudinal direction. It melts before the blowpipe into a black globule. Sp. gr. 3.24.

It consists of silex 55.25, oxide of iron 31.25, soda 10.40, oxide of manganese 1.08. Resembles pyroxene, and is found imbedded in granite.

ARFVEDSONITE.

Color black: it has a cleavage parallel to the planes of a rhombic prism of 123° 55′, with brilliant faces. It melts into a black globule. Sp. gr. 3.44.

BABINGTONITE.

Color black, often greenish in thin splinters: fracture conchoidal: lustre vitreous: scratches glass. Resembles the darker varieties of pyroxene.

BREWSTERITE.

This mineral was considered as an apophyllite until its examination by Mr. Brooke. It occurs in small prismatic crystals, terminated by two planes: it is nearly transparent and colorless, and of a yellow tinge: primary form an oblique angled prism. It is accompanied by calc. spar.

BROCHANTITE.

Color emerald-green: transparent: insoluble in water. It consists of oxide of copper, sulphuric acid, and a portion of silica and alumine.

BROOKITE.

Color hair-brown, passing into deep orange-yellow, with some reddish tints: lustre metallic-adamantine. Streak yellowish-white: translucent—opake: the brighter colors are observed by transmitted light: brittle: has the hardness of glass. It contains titanium.

BUCKLANDITE.

Color dark-brown, nearly black: harder than pyroxene, which it resembles.

CHILDRENITE.

Color yellowish-white, wine-yellow, ochre-yellow and pale yellowish-brown: streak white: translucent: lustre vitreous inclining to resinous. It is found to be a compound of phosphoric acid, alumine and iron.

CHLOROPAL.

Massive: fracture conchoidal, passing into earthy: color pistachio-green: opake or scarcely translucent on the edges: fragile: equals fluor in hardness. Sp. gr. 2.00.

It consists of silex 46, oxide of iron 35.30, manganese 2, alumine 1.00, water 18. It is remarkable for its magnetic properties. When taken from its original repositories, it breaks readily in parallelopipeds, the upper end and two adjoining lateral edges having opposite magnetic poles from the two other edges and the lower end.

CHUSITE.

Occurs massive, either compact or granular: lustre greasy: it melts easily into a translucent enamel and dissolves entirely with effervescence in acids.

COMPTONITE.

It is found only in small crystals; which are whitish and translucent, or white and opake: it cleaves parallel to the lateral planes of a right rectangular prism of which the bases are not square: harder than stilbite, but not so hard as mesotype: nitric acid converts its powder into a jelly. It occurs in amygdaloid.

COUZERANITE.

Color varies from greyish-black to indigo-blue: opake, except in thin portions which are translucent: crystals occur mostly fasciculated: form a rectangular prism, but the lateral edges are often replaced by planes, so as to give the crystal the form of a rhombic prism.

It is insoluble and infusible.

CARBONATE OF MAGNESIA AND IRON.

This substance has usually been supposed to be a carbonate of magnesia and lime, and like it may be cleaved into rhomboids, but its angles are different, being 107° 30′ and 72° 30′. It contains carbonate of iron 13.15, carbonate of magnesia 86.05. Imbedded in chlorite.

CUPREOUS MANGANESE.

Color bluish-black: opake: fracture imperfectly conchoidal: lustre resinous. Before the blowpipe it becomes brown, but does not fuse; to bo-

rax and salt of phosphorus it communicates the colors of copper and manganese.

It consists of black oxide of manganese 82, brown oxide of copper 13.50, silex 2.

DOMITE.

Color white, or greyish-white, or tinged with yellow. It has the aspect and gritty feel of chalk, and soils the fingers when white: friable. It is considered by some a decomposed feldspar. It forms large beds and is used as a building stone.

EUDIALYTE.

Color brownish-red : streak white : lustre vitreous : translucent on the edges—opake : nearly scratches glass. Before the blowpipe it melts into a leek-green scoria. Its powder gelatinizes with acids.

It consists of silex 52, zirconia 10.89, lime 10. 14, soda 13.92, oxide of iron 6.85, oxide of manganese 2.57, muriatic acid 1.03. It is associated with pyroxene and feldspar.

FERGUSONITE. *(ALLANITE in part.)*

Color dark brownish-black, in thin splinters pale : streak pale-brown : translucent in thin splinters : lustre imperfect metallic, inclining to resinous : brittle : equals glass in hardness. Before the blowpipe it becomes pale greenish-yellow, but does not melt. It is entirely dissolved in salt of phosphorus, but some particles remain a long time unaltered. It has been considered as yttro-tantalite.

FUSCITE

Color greyish or greenish-black : opake. It

yields to mechanical division parallel to the planes of a rhombic prism of about 87° 8' and 93°, apparently with inclined summits; in this respect resembling the primary form of pyroxene. Before the blowpipe it becomes shining and enamel like. Sp. gr. 2.5—3.

GIESECKITE.

Color olive-green, grey or brown: streak uncolored. It occurs in regular six-sided prisms, but possesses no regular cleavage: lustre waxy. It appears more like a pseudomorphous steatitic mineral than a crystalline substance. It scratches common glass on which the white powder of the mineral is left. Sp. gr. 2.7—2.9.

It consists of silex 46.27, alumine 33.82, magnesia 1.2, potash 6, oxide of iron 3.35, water 4.8.

GMELINITE. *(SARCOLITE OF VAUQUELIN.)*

Color white, passing into flesh-red: streak white: translucent: equals fluor in hardness. It possesses the property of flying off in minute scales when placed in the flame of a candle.

It consists of silex 50, alumine 20, lime 4.50, soda 4.50, water 21. It has no connection with the analcime, but is more analagous to the leucite.

HISINGERITE.

Color black: massive: cleavage in one direction; in other directions fracture is earthy. Before the blowpipe, it soon becomes attractable by the magnet, and by continuing the heat it is reduced to an opake drossy globule: with borax it gives a yellowish-green glass. Sp. gr. 3.04.

It occurs in calc. spar.

HOLMITE.

It is a variety of carb. of lime, but is remarkable for its specific gravity, which is 3.59. It was picked up among paving stones.

It consists of lime 27, carb. acid 21, oxide of iron 29, alumine $6\frac{1}{2}$, silex $6\frac{1}{2}$.

HOPEITE.

Color greyish-white : streak white : transparent—translucent : lustre vitreous : surface often striated : soft. Before the blowpipe it melts easily into a clear colorless globule, which tinges the flame green. Fused with soda it gives a yellow scoria while hot ; copious fumes of zinc, and some cadmium, are deposited nearest the scoria. The melted mineral forms a fine blue glass, with solution of cobalt. It has some resemblance to stilbite. It is found with the zinc ores of Altenbergh.

HUMITE.

It occurs in small crystals of a deep reddish-brown color : translucent—transparent : lustre shining. Its primary form is considered a right rhombic prism of 60° and 120°, but they yield to division parallel only to its shorter diagonal : crystals are modified in an extraordinary degree.

KNEBELITE.

Color grey, spotted with dirty-white, brownish-red, brown and green : surface cellular and uneven : opake : hard, brittle, and with difficulty frangible. Sp. gr. 3.71.

It consists of silex 32.5, protoxide of iron 32.0, protoxide of manganese 35.

KONILITE.

It occurs in a loose white powder, somewhat

coarser than silex, obtained from silicated alkalies. It does not scratch glass. Before the blowpipe it melts immediately into a transparent bead: muriatic acid takes up a large quantity of lime, but does not destroy its fusibility. It is considered at present as nearly pure silex. It occurs in cavities in amygdaloid.

LATROBITE.

Color pale-red. It has a cleavage in three directions, intersecting each other at angles of 98° 30′, 91° and 93° 30′: scratches glass. Before the blowpipe it melts into a white enamel. With borax it yields a globule, pale amethyst-red, in the oyxdating flame, and colorless in the reducing one. Sp. gr. 2.72.

It consists of silex 41, alumine 32.82, lime 8, oxide of manganese 5.76, potash 6.5, water 2.

LEVYNE.

Color white: streak white: semi-transparent: brittle: equals fluor in hardness: intumesces on charcoal, and becomes opake. It occurs in amygdaloid.

LIGURITE.

Color apple-green: transparent, with a vitreous lustre: powder greyish-white. It occurs in oblique rhombic prisms of 140° and 40°. Sp. gr. 3.49.

It consists of silex 57.45, alumine 7.34, lime 25.30, magnesia 2.56, oxide of iron 3. It occurs in a talcose rock, and is considered a gem in hardness, color and transparency.

LIMBILITE.

Color honey-yellow: compact: scratches glass,

and melts into a compact black enamel. It occurred in a volcanic hill of Limbourg.

MARGARITE.

Color greyish-white : occurs in small crystalline laminæ, intersecting each other in every direction. It resembles silvery mica.

OMPHACITE.

Color various shades of green, but mostly deep grass-green. It occurs in small crystallized filaments, nearly transparent. It yields to mechanical division parallel to the planes of a rhombic prism. It is supposed to be a variety of hornblende.

PICROLITE.

Color green or yellow : massive : fracture splintery : dull : infusible. It is said to be principally carbonate of magnesia.

PICROSMINE.

Color greenish-white, passing into greenish-grey and mountain-green ; sometimes oil, leek or blackish-green : streak white : dull : translucent on the edges—opake : fracture uneven, scarcely perceptible : receives an impression from the nail. Sp. gr. 2.66.

Infusible, becoming first black, then white and opake, and nearly as hard as glass.

ROSELITE.

Color deep rose-red : streak white : translucent. It equals calc. spar in hardness. Before the blowpipe it gives off water and becomes black. It imparts a blue color to borax and salt of phosphorus, and is entirely soluble in muriatic acid.

It is composed of cobalt, lime, arsenic acid and magnesia.

SIDERITE.

Color greyish or greenish-blue. It is nearly as hard as quartz, and possesses a resinous lustre. It has been confounded with lazulite. It occurs in gypsum.

SIDEROCLEPTE.

Color yellowish-green : yields to the nail : lustre weak : infusible, but becomes deep brilliant black. It occurs in lava in the form of round masses with concentric coatings.

SOMERVILLITE.

Color pale dull-yellow : hardness inferior to garnet, but more glossy in the cross fracture. It decrepitates before the blowpipe, and melts into a grey colored globule.

THULITE.

Color rose-red. It occurs in crystalline masses, which yield to mechanical division parallel to the lateral planes of a rhombic prism of 87° 30′ and 92° 30′ : yields with difficulty to the knife, affording a greyish-white powder.

WAGNERITE.

Color several shades of yellow, sometimes scarcely orange-yellow, often inclined to grey : streak white : translucent : lustre vitreous. Nearly as hard as glass. Sp. gr. 3.11.

It consists of phosphoric acid 41.73, fluoric acid 6.50, magnesia 46.66, oxide of iron 5, oxide of manganese 0.50. It is found in clay slate.

WITHAMITE.

Color carmine-red and pale straw-yellow, in two different directions, perpendicular to each other: streak white: translucent: brittle: scratches glass. Before the blowpipe it intumesces, but fuses with difficulty into a dark greenish-grey scoria. It has a strong resemblance to epidote. Sp. gr. 3.13.

WOLLASTONITE.

It is a very doubtful substance; having been supposed to be a variety of hornblende, meionite, and finally of tabular spar.

ZEAGONITE.

It occurs in semi-globular masses and in crystals, in the form of an octaedron, with a square base. Color greyish-white, occasionally with a tinge of blue, and rarely of red: yields to the nail: translucent—transparent.

ZURLITE.

It is described as occurring in rectangular prisms, flattish and rough externally, and with convex faces: color asparagus-green: yields to the knife. Before the blowpipe with borax it is reduced to a blackish glass. Sp. gr. 3.27.

It is found with calc. spar.

INTRODUCTION

TO THE

STUDY OF GEOLOGY.

1. Geology is that science, which investigates the structure, position, direction, and relative situation of those large masses, beds, strata and veins of minerals, which compose the exterior crust of the earth. It likewise notices those changes and alterations produced by frost, rain, floods, earthquakes and volcanic fires. These changes, some of which are constantly, but slowly operating, have greatly modified the earth's surface since the creation. But in accounting for *all* the present appearances of the earth's surface, we are obliged to recognize periods of time during which important changes have been wrought, for which there are now no adequate existing causes in operation. Geology therefore aspires to the assigning of at least probable causes for the present appearance of the earth's surface.

2. Extensive observation has clearly proved the existence of a regular succession of strata, or that rocks lie over or rest on each other, in a certain order. Sometimes only one rock is present, but generally two or more different rocks occur together. The order of arrangement or alternation of rocks, constitutes the most interesting branch of inquiry.

3. From this regular succession, or series of rocks, important applications are made in searching for the more

useful minerals, as gypsum, rock salt, bituminous and anthracite coal, the various kinds of ores, metals, gems, &c.

4. Geologists of the present day recognize in the series of rocks, five general divisions or classes ; as primitive, transition and secondary, superincumbent and alluvial.

5. Those rocks which are denominated primitive, have a texture more or less crystalline ; contain no petrifactions, and are relatively the lowest in the series.—When stratified their strata are highly inclined, and often vertical. Secondary rocks, on the contrary can scarcely be called crystalline in their texture, but appear like mechanical deposits, composed of grains which once belonged to primitive rocks. They contain petrifactions of animals and plants. When they approach primitive strata, they are more or less inclined, and appear as if thrown into this position after induration by some power or force applied beneath the primitive rocks.

6. It appears to be admitted by all geologists that the materials of the earth must have been at some former period in a fluid state, and that they must have been brought and held in this state either by caloric or water : that minerals were deposited from this fluid state, and that the waters of the ocean once covered the tops of the highest mountains. But it is not clearly settled which of these agents was the solvent. Hence there have arisen two geological systems, according as the principal agency in the production of the mineral kingdom is attributed to water or caloric—the one called the *Neptunian* theory, the other the *Volcanic* ; or more properly, after their respective supporters, as Wernerian and Huttonian. The latter at the present day seems more

likely to prevail, though with some essential modifications.

7. The order in which rocks are usually recorded, is to begin with the lowest in the general series and proceed to the highest. But of late some of the English geologists of the first standing, commence at the other end of the series, by describing the most recent strata, and proceed downwards, dividing the numerous strata into five orders, and naming them according as they are above or below the middle order.

The following synoptical view, which is extracted from the work of Conybeare and Phillips, will give the student a view of their arrangement of rocks and of the softer strata.

Character.	Proposed names.	Wernerian names	Other writers.
1. Formations (chiefly of *sand & clay*) *above the chalk.*	*Superior order.*	Newest floetz class	Tertiary class.
2. Comprising *a. Chalk.* *b.* sands and clays *beneath the chalk.* *c.* calcareous freestones *(oolites)* & argillaceous beds *d. New red sandstone, conglomerate & magnesian limestone.*	*Supermedial order.*	Floetz class.	Secondary class
3. Carboniferous rocks comprising *a. Coal measures.* *b. Carboniferous limestone.* *c. old red sandstone*	*Medial order*	Sometimes referred to the preceding sometimes to the succeeding class by writers of these schools; very often the coal-measures are referred to the former—the subjacent limestone and sandstone to the latter.	
4. *Roofing slate, &c.*	*Submedial order.*	Transition class.	Intermediate class.
5. *Mica slate.* *Gneiss.* *Granite, &c.*	*Inferior order.*	Primitive class.	Primitive class.

ARRANGEMENT OF ROCKS.

The following arrangement of rocks, which is extracted from Professor Eaton's work on the rocks of the canal district, will be adopted in this Manual, as it comprises the best system of North American Geology, which has been published:

I. PRIMITIVE CLASS.

1. Granite.
2. Gneiss.
3. Mica Slate.
4. Hornblende rock.
5. Talcose rock.
6. Granular quartz.
7. Granular lime rock.
8. Sparry lime rock.
9. Primitive argillite.

II. TRANSITION CLASS.

10. Transition argillite.
11. Calciferous sand-rock.
12. Metalliferous lime-rock.
13. Graywacke.
14. Old red sandstone

III. SECONDARY CLASS.

15. Millstone grit.
16. Saliferous rock.
17. Grey band.
18. Ferriferous slate.
19. Ferriferous sand-rock.
20. Calciferous slate.
21. Geodiferous lime-rock.
22. Cornitiferous lime-rock.
23. Pyritiferous rock.

IV. SUPERINCUMBENT CLASS.

24. Amygdaloid.
25. Greenstone trap.

V. ALLUVIAL CLASS.

Considered under three divisions.

1. Antediluvial.
2. Diluvial.
3. Postdiluvial.

GENERAL DESCRIPTION

OF

NORTH AMERICAN ROCKS.

I. PRIMITIVE CLASS,

Includes those rocks which never contain any organic relics, nor coal.

1. GRANITE,

Is an aggregate of quartz, feldspar and mica, disposed irregularly in the mass. Feldspar usually predominates and gives character to the rock, which is called *grey* or *red*, according to its color. When the quartz is so arranged or disseminated in the feldspar as to present somewhat the appearance of Chinese letters, it is called *graphic granite*. When the feldspar appears in rectangular solids, it is *porphyritic*. Granite is either coarse or fine: sometimes the quartz and feldspar is in large masses or blocks and the mica in plates, several inches in diameter; again the ingredients are fine and so intimately blended, as to present an homogeneous aspect. It occurs in *beds* and *veins*. When in veins it traverses granite, gneiss, mica slate, and sometimes hornblende rock. The width of the veins vary from half an inch to many feet. They are often contorted or twisted, or pursue a serpentine course. Granite is a rock which exists extensively; and in many countries it occurs in immense quantities. It constitutes a large portion of many of the highest mountains, of which it forms the central parts, as well as the summits. It also occurs in situations apparently low, either

having never been covered by other rocks, or having been left naked by the disintegration and removal of those rocks which once rested upon it.

Granitic aggregates. Sometimes one or two of the ingredients of granite is wanting, in the room of which some mineral is present.

Thus aggregates of the following description occur: feldspar and mica—quartz and feldspar—quartz, mica and garnet—quartz, feldspar and schorl—feldspar, mica and hornblende, &c. and these frequently form considerable large masses in primitive mountains, and perhaps deserve to be described under some appropriate name, as subordinate to granite or gneiss.

Mineral contents. Green, blue and red tourmaline, spodumene, emerald, crysoberyl, cyanite, garnet, plumbago, sulphuret of molybdena, sulphuret of lead, sulphuret of zinc, sulphuret of copper, sulphate of lead, sulphate of barytes, fluate of lime, magnetic iron.

Agricultural character. Granite slowly disintegrates, forming a siliceous soil which is not very productive if unmixed.

Uses. Granite forms a beautiful durable building stone, and is usually split into blocks and wrought with ease. The feldspar often becomes decomposed, and then forms a valuable clay for the manufacture of porcelain. Likewise, when it exists in sufficient quantity, and can be separated from the mica, it may be considered as valuable as its clay, it being equally important in the manufacture of that beautiful ware.

Localities. Chesterfield, Middlefield, Chester, Hinsdale, Mass.

II. GNEISS.

This rock like granite is essentially composed of quartz, feldspar and mica, but its ingredients are stratified, or in other words the mica is arranged in parallel layers. This rock though always more or less slaty, is seldom perfectly *fissile*. It splits however in the direction of the strata, and especially when the separation is made in a layer of mica. *Gneiss* contains more mica and less feldspar than granite, but viewed in the extremes and when passing into granite, the feldspar predominates, and in passing into mica slate, the feldspar diminishes and finally disappears.

The color and hardness of gneiss is variable, and its mica and feldspar are subject to the same changes as when they exist in granite.

1. *Glandulous Gneiss.* This variety, in which the mica is often arranged in undulated layers, presents numerous small masses of quartz, of a globular or elliptical form, interspersed like *glands* through the mass.

Mineral contents. Schorl, tourmaline, garnet, hornblende, actynolite, emerald, zircon, chrysoberyl, talc, iron pyrites, plumbago, magnetic iron, &c.

Agricultural character. The oldest gneiss is not subject to hasty disintegration. Besides its being a pretty hard rock, it is defended from the operations of disintegrating agents by the highly inclined position of its layers, whereby its thin edges only are exposed. But when it approaches a more horizontal position, and passes into a sandy variety, it disintegrates rapidly and forms a meagre, loose, sandy soil.

Uses. The varieties which split or are capable of being separated into regular blocks, are valued as a building stone.

Localities. Peru, Washington Mountain, Spencer, Haddam, Conn.

III. MICA SLATE.

Mica slate is composed essentially of quartz and mica, which are generally more or less intimately mingled; but sometimes the ingredients alternate in distinct layers. The proportions of mica and quartz are variable, but usually the mica predominates. Structure always distinctly slaty, and its masses are often very *fissile*. The layers are straight, curved or undulated. In some varieties the texture is very fine, and the folia of mica extremely minute, so that the rock almost appears homogeneous. Viewed in the extremes, when approaching gneiss, it becomes coarse and imperfectly fissile, but in more recent varieties it approaches the primitive argillite and is completely fissile.

Mineral contents. Garnet, cyanite, staurotide, magnetic iron, pyrites. It contains beds of various minerals, as granular limestone, hornblende, actynolite, serpentine: likewise ores both in beds and veins.

Agricultural character. It disintegrates more rapidly than either of the preceding rocks, but its soil is sandy and loose, requiring the admixture of clay and calcareous manure to render it productive.

Uses. When fissile, it is a useful building stone: it likewise forms good hearths for furnaces when free from garnet or the more fusible minerals.

Localities. Chesterfield, Worthington, Chester,* Middlefield, Plainfield, Cummington, Mass. It appears to rest on gneiss at all the localities I have examined.

IV. HORNBLENDE ROCK.

It consists of pure hornblende, or hornblende and feldspar. When the feldspar is in disseminated masses, it is denominated *sienite*, or sienitic granite; when in thin layers, so as to form fissile masses, slaty hornblende. The predominant color of the rock is always green, sometimes inclining to brown.

Hornblende often alternates with other rocks, as gneiss and mica slate. With the latter, in Chester, Mass. it alternates 15 or 20 times in as many rods at one locality. The layers vary in thickness from 2 inches to 2 feet, and are ferquently twisted or contorted in the most singular manner.

Mineral contents. Epidote, actynolite, crystals of feldspar, gold, copper, nickel, cobalt, arsenic, bismuth, antimony, titanium.

Agricultural character. Hornblende rocks are subject to moderate disintegration, and form a rich and durable soil.

Uses. The toughness and fissile nature of hornblende renders it useful in building and constructing of forts. The sienite variety is susceptible of a polish, and forms beautiful pieces for ornament.

Localities. Chester, Middlefield, Plainfield, Cummington, Windsor, Mass. In Middlefield, near the soap stone quarry, hornblende can be distinctly seen to pass into mica slate laterally.

* Chester, in Massachusetts, furnishes the most interesting variety of mica slate in New England, particularly at the place called Sizer's ledge.

V. TALCOSE ROCK.

Is an aggregate of talc and fine grains of quartz, and generally some mica. It differs but little from mica slate in many localities, as it contains but little talc in addition to the essential ingredients of mica slate. In the extremes when approaching mica slate, the talc nearly disappears; on the other side, as the talc increases, it passes into pure soap stone or steatite.

Talcose rock is usually slaty, and the layers are thinner and more tender than mica slate. Color in the mass, usually of a silver grey. Layers are often curiously bent or contorted.

Mineral contents. Magnetic iron, more abundant at the meeting of mica slate and talcose rock, actynolite, steatite, serpentine, asbestus, chlorite, garnet, copper, chrome, hydrate of magnesia.

Agricultural character. Similar to mica slate.

Uses. That variety in which talc greatly predominates, as in steatite and potstone, forms an excellent building stone.

General remarks. Serpentine, at all the localities in Windsor, Middlefield and Chester, is interposed in beds, more or less extensive between hornblende rock and talcose rock. Sometimes the serpentine is only a few rods in extent; again it continues a mile or two, forming bare and naked cliffs.

VI. GRANULAR QUARTZ,

Is made up of grains of quartz in a state of aggregation, without the appearance of any cement. Structure always finely granular and without any appearance of rolled pebbles. When of a yellowish hue it is called *yellow* granular quartz, when

white or whitish, it is *white* granular quartz. It is generally opake, but sometimes translucent at the edges.

Mineral contents. It is not known to contain any imbedded minerals.

Agricultural character. This rock is but slowly disintegrated, and the soil which it produces must be a siliceous sand.

Uses. When white and free from iron, its sand becomes an excellent material in the manufacture of glass.

VII. GRANULAR LIMEROCK,

Is made up of grains without any cement, and has more or less the crystalline appearance: structure varies from coarse to fine granular, commonly translucent at the edges. Color often a pure white, but sometimes grey and greyish white. When its layers are thick, compact and straight, it may be wrought, and is called *statuary marble.* It is often divided into thin layers by seams of talcose slate. It passes into granular quartz rock and into dolomite.

Mineral contents. Calcareous spar in small beds, tremolite, serpentine, pyroxene, asbestus, brown tourmaline, iron pyrites, titanium, and sometimes chrome, brucite, nephrite.

Agricultural character. This rock is subject to chemical decomposition as well as ordinary disintegration. It makes a rich soil in combination with a due proportion of clay and sand.

Uses. Granular limerock receives a high polish, and is extensively used for monuments, pillars, and in building.

Localities. It accompanies the granular quartz, and may be seen at the foot of hills through the county of Berkshire, Mass.

VIII. SPARRY LIMEROCK,

Is made up of extremely fine grains of carbonate of lime, united without the intervention of any cement. Its best and most distinctive characters, are its *veins* of calcareous spar: colors more variegated than granular limerock, and of a finer grain, approaching compact limestone. Sometimes the rock continues several yards uninterrupted, it is then cut off by veins of pearly calcareous spar; and again it appears checked or cut up into small blocks, not exceeding five or six inches in extent. It has a great resemblance in color to the Nova Scotia plaster. It is sometimes slaty.

Mineral contents. It contains but few imbedded minerals. Lead and antimony are the most important which have been noticed.

Agricultural character. This is subject to the same decomposition and disintegration as the preceding rock, and like it forms an excellent soil, peculiarly fitted for the growth of wheat and rye.

Uses. It is sometimes sufficiently free from spar to be wrought as a marble.

General remarks. From this stratum nitrogen gas is supposed to issue in vast quantities.

Localities. At the east foot of Williamstown mountain; also on the west side, along the little Hoosick.

IX. PRIMITIVE ARGILLITE,

Is a homogeneous rock, whose structure is always slaty. Its layers or tables are often undu-

lated, and covered with a talcose crust, giving them a shining surface. When it contains plumbago so as to afford a trace on paper, it is called *graphic slate.* When by decomposition it affords alum, it is called *alum slate.* This rock is not stratified but lamellar, and its laminæ stand at an angle of 50 or 60 degrees with the general direction of a stratum. It is supposed to owe its lamellar structure to crystalline arrangement. Its colors are greatly variegated, being sometimes deep red, brick color, purple, bluish-purple, green and slate color. Though its laminæ are often curved, yet it affords many localities of good roofing slate.

Mineral contents. Milky quartz, chlorite, red and striped jasper, marl, plumbago, talc, manganese, copper, sulphuret of lead.

Agricultural character. This rock forms a clay soil, which when duly compounded with that produced by the sparry limerock which skirts its sides, forms a very productive soil.

Uses. When its laminæ are straight and free from imbedded minerals, it may be wrought for roofing slate.

Localities. Williamstown mountain, on the road leading from West Stockbridge to Hudson, three miles on the New-York side, it occurs red, brick color, purple, bluish-purple, blue, green, and slate color. Washington, Columbia, and Orange counties ; and near the west line of Vermont, in the town of Granville. The alum slate variety is found 5 miles north of Williams college, in Pownal, Vt. The Williamstown mountain range extends into Canada on the north, and into

New-Jersey on the south—a distance of between three and four hundred miles.

II. TRANSITION CLASS.

Includes those rocks which, in some localities, are known to contain anthracite coal, or marine organic relics, but never contain bituminous coal, nor dry land or fresh water petrifactions.

X. TRANSITION ARGILLITE,

Is a soft homogeneous rock, mostly of a bluish or dark brown color. It differs from primitive argillite, in being softer, its slaty layers being more vertical, less shining, more uniform in its color, and more subject to rapid disintegration: and what is more distinctive, in containing organic relics. When its layers are covered with a thin coat of hard carburet of iron, it is called *glazed slate.* When it decomposes and forms alum, it is called *alum slate.* It passes into and embraces in beds, both *flinty* and *jaspery* slate. Its laminæ are often bent and twisted in every direction.

Mineral contents and organic remains. Alum, epsom salts, milky quartz, jaspery slate, lydian stone, anthracite, plumbago, mercury, lead, copper, manganese, iron pyrites. Orthoceratites, anomites, and sertularites.

Agricultural character. This rock is more easily broken down into soil than the primitive argillite, but it contains too much clay when unmixed. When compounded, however, with limestone, graywacke or sandstone, it is made productive and durable.

Uses. This rock is not well suited for build-

ing stone. When its laminæ are straight it forms good roof or cyphering slate.

Localities. Cohoes; glazed kind, Mount Olympus; jaspery slate, three miles south of Albany; flinty slate, at and below the city of Hudson, forming a high bluff; opposite Troy.

XI. CALCIFEROUS SANDROCK,

Is essentially composed of quartzose sand and fine grains of carbonate of lime. The proportions of the constituents are variable, but the quartz generally predominates. On exposure, the carbonate of lime disappears, leaving a mere siliceous surface of a harsh and meagre feel. It abounds in geodes which are lined with quartz crystals. The surface of exposed parts of this rock is very uneven, presenting projections which have the general appearance of petrifactions of irregular bodies.

Mineral contents and organic relics. Quartz crystals, calc. spar, sulphate of barytes, brown-spar, anthracite, silver, mercury, lead, copper, zinc, antimony.

Agricultural character. When uncompounded it forms a meagre soil, but when blended with clay it becomes rich.

Uses. It has been used as a substitute for water limestone. It forms a good building stone.

Localities. Flint hill, in Florida; extensive and important rocks among the ridges and spurs of Macomb's mountains.

XII. METALLIFEROUS LIMEROCK.

Color grey or slate color: structure compact: opake: fracture conchoidal. It is sometimes

slaty, but the layers are always compact. The recent fracture discovers many small pearly masses of calc. spar. It differs from sparry limerock in its fracture, and by the absence of veins of calc. spar. It contains numerous petrifactions. Accompanies and reposes on the calciferous sandrock.

Mineral contents and organic relics. Silver, lead, copper, gold, mercury, zinc. Encrinites, entrochites, anthocephalites, terebratulites, gryphites, orthoceratites, belemnites, trilobites, turbinites, and stylastrites.

Agricultural character. Whenever it becomes soil it enriches it like other limestone rocks.

Uses. It is used for the manufacture of lime, and is wrought for marble, its petrifactions greatly enhancing its beauty.

Localities and extent. This rock on the east side of the Hudson, appears at different intervals, from Barnegat to near Lake Champlain, and thence to Canada. It may be examined one mile east of Schoharie-kill, and along the ledge south of Canajoharie. It accompanies and rests upon the calciferous sand rock in Macomb's mountains. In South America this rock is rich in silver and other valuable minerals.

XIII. GRAYWACKE,

Is an aggregate of *angular* grains of quartzose sand, cemented by indurated clay. It generally contains glimmering scales of talc and mica. Color generally grey, but sometimes it is colored green by chlorite, and red by oxide of iron. When it contains large pebbles, fragments of argillite, or slaty graywacke, it is called *rubblestone.*

Graywacke assumes a great variety of charac-

ters. It is coarse, fine, harsh, soft, smooth, fissile, brittle and strong: grey, blue, green and red. It appears in high ledges and at the bottom of low vallies. It is sometimes found in globular masses, or concentric spheres. It is considered by some geologists, to be geologically the highest rock which contains metals in veins.

Mineral contents. Grinstone grit and hone stone in beds; quartz, calcareous spar, anthracite, carbonate of barytes, alum, chlorite, copper, lead, manganese, silver, gold, antimony. Anomites, pectenites, pentacrinites; the latter in the bed of the Mohawk, five or six miles west of the Cohoes.

Agricultural character. The soil in some varieties contains too much clay unmixed, but the siliceous varieties make a sandy soil.

Localities and extent. This rock spreads over most of the state of New-York, west of the sparry limerock. It is found capping most of the hills and eminences in the counties of Rensselaer, Washington and Columbia. It constitutes most of the Catskill and Allegany mountains. The variety colored by chlorite, is found in the hills of Peterborough. The rubblestone is found very abundant in the graywacke district connected with the Catskill mountains.

XIV. OLD RED SANDSTONE,

Is an aggregate of *angular* grains of quartzose sand, cemented by a ferruginous, argillaceous cement. If pulverized and washed the grains of quartz appear glassy and nearly transparent. It contains glimmering scales like graywacke slate, but the interstices between the grains of quartz

are not filled like those of graywacke. The old red sandstone forms the stratum, which underlays the most important coal measures in Europe; when it is wanting we must take the rock whose geological place is next beneath it for the true floor of the coal formation, which is graywacke.

Mineral contents and organic relics. Quartz, iron, copper. Corallinites.

Agricultural character. It is not subject to rapid disintegration. It forms a red, loose, and meagre soil; when compounded with clay it forms a rich and durable soil.

Uses. It is esteemed a valuable and durable building stone. It is wrought under the name of freestone.

Localities and extent. It forms the banks of Connecticut river. It is abundant near the top of Catskill mountain. Petrifactions of corallines. one mile south of Pine Orchard.

III. SECONDARY CLASS.

Includes those rocks which sometimes contain bituminous coal, or fresh water or dry land relics, as well as those of marine origin. Some specimens in every stratum effervesce with acids.

XV. MILLSTONE GRIT,

Is a coarse, harsh aggregate of quartzose sand and pebbles, apparently held together by the attraction of adhesion, without cement. Color grey or yellowish-grey, sometimes reddish. The millstone grit in the canal district rests on graywacke. In Europe this rock always accompanies the most important coal measures. It often passes into a

coarse conglomerate of rounded quartzose pebbles.

Mineral contents. Quartz, bituminous coal, carburetted hydrogen.

Agricultural character. By disintegration it produces a gravelly sandy soil.

Uses. The conglomerate variety is well suited for the manufacture of millstones.

Localities. Starch Factory Creek, and Factory or Steel's creek; Westmoreland; in lower Genesee falls.

XVI. SALIFEROUS ROCK,

Is an aggregate of minute *rounded* grains of quartzose sand, or of minute argillaceous and quartzose grains, formed into red or greenish sandstone, or soft red or greenish brittle clay slate. It contains no glimmering scales except in a few instances. It constitutes the floor of all the salt springs in the western country.

Mineral contents and organic relics. Quartz, common salt, glaubers salts, muriate of lime, muriate of magnesia, coal, mercury. Bones of quadrupeds.

Agricultural character. The slaty part of this rock disintegrates rapidly into red soil, which is rich and productive.

Uses. It is easily wrought, and has recently come into use as a building stone, particularly at Rochester.

Localities. In the side hill along the south side of the canal, from near Little Falls to Utica; at Vernon, Oneida creek, Lenox, Salina, from 4 miles west of Rochester to Lockport, Lewiston, ten miles north of Tonawanta.

XVII. GREY BAND,

Is a hard fine grained grey rock, which is so compact that it may be considered homogeneous. It is considered the coal roof where the saliferous rock is discontinued, as it rests immediately on that rock. Variable in hardness, and becomes soft on exposure. It is a thin rock, varying from 4 to 15 feet. It is interposed between the red saliferous rock and bluish-green ferriferous slate.

Mineral contents. Quartz, salt.

Uses. It breaks into square faced blocks, and is used as a building stone. It takes an indifferent polish.

XVIII. FERRIFEROUS SLATE,

Is a soft argillaceous, almost homogeneous rock; color greenish, blue and bluish-green: brittle: structure scaly, shelly or imperfectly laminated. It is beneath the red argillaceous iron ore, or embraces it in alternating layers.

Mineral contents and organic relics. Argillaceous and jaspery iron ore. Helix, limnœa.

Localities. Verona mines, Genesee Falls, Niagara.

XIX. FERRIFEROUS SANDROCK,

Is a massive aggregate of quartzose grains, often hyaline, held together apparently by the attraction of adhesion. Color grey or yellowish-grey, and sometimes reddish, being colored by the argillaceous iron ore which it embraces or overlays. It is a hard siliceous rock, unlike the slate which it always accompanies, and breaks into thick blocks. At Genesee Falls this rock is fourteen feet thick, and the slate rock twenty three.

Mineral contents. Quartz, sulphuret of zinc.

Agricultural character. It produces a meagre siliceous soil, and is much improved when compounded with the aluminous soil formed by the slaty rock beneath.

Localities. It appears frequently in the bed of the canal from a little west of Rome to Montezuma, Genesee, and Niagara Falls.

XX. CALCIFEROUS SLATE,

Is an aggregate of quartzose sand and clay slate. Under the magnifier the grains appear rounded, and it is destitute of shining scales, which will distinguish it from graywacke. Color grey: sometimes it is in a thin slate; but it is often hard and siliceous, and rings on being struck. It embraces the plaster beds, water lime beds, shell limestone beds, through its whole extent. It often contains fine grains of carbonate of lime sufficient to produce considerable effervescence in acids. It embraces a dark blue or grey rock, perforated every where on the external surface with holes, which are sometimes lined with a thin crust: this is called *vermicular limerock.*

Mineral contents. Fibrous barytes, calc. spar, nitrate of potash, nitrate of lime, sulphate of magnesia, sulphate of alumine and potash, sulphate of iron, sulphuret of lead.

Agricultural character. It forms by disintegration the best of soil.

Localities. It forms the principal rock south of the canal from Oneida creek to Pittsford. Its thickness may be examined near Limestone Creek.

XXI. GEODIFEROUS LIMEROCK, *(SWINE STONE,)*

Is an amorphous irregular limerock, which abounds in geodes. It is generally fetid on being struck, often dark colored, but sometimes light grey. When kilns are burning for the manufacture of lime, the smell of horn or leather is perceived at considerable distance. It always rests immediately on the calciferous slate, and is the highest rock in the canal district, excepting where it passes under the cornitiferous limerock.

Mineral contents and organic relics. Snowy gypsum, selenite, hogtooth spar, brown spar, fluor spar, sulphuret of zinc of a waxy color, sulphate of strontian, quartz crystals. Asterites, encrinites, turbinites, pectenites, gryphites, isidites.

Agricultural character. The soil reposing on this rock is probably unequalled for the production of wheat.

Localities. Lockport, Niagara Falls. At the former place it is 50 feet thick, at the latter 70.

XXII. CORNITIFEROUS LIMEROCK, *(Or, second shell Limerock,)*

Is made up of shell limestone layers, embracing layers and beds of hornstone. It rests on the geodiferous limerock, or when that is discontinued on the calciferous slate. It is remarkable for its numerous caverns and fissures.

Localities. Black Rock, Niagara Falls, Bethlehem.

Organic relics. Encrinites, entrochites, anthocephalites, chamites, gryphites, terebratulites, orthoceratites, volutites, turbinites, common madreporites, retiporites, horn form madreporites, favosites, isidites, alcyonites.

XXIII. PYRITIFEROUS ROCK, *(PYRITOUS SHALE,)*

Is a siliceous or calcareous grey rock, with alluminous cement, either slaty or in blocks, and abounding in iron pyrites. It abounds in petrifactions which often consist of pyrites. It decomposes and disintegrates rapidly. Structure sometimes slaty, but often breaks into square faced blocks.

Mineral contents and organic relics. Bitumen, coal, sulphuretted hydrogen, sulphate of iron, sulphate of magnesia, sulphate of alumine and potash, iron pyrites. Anomites, favosites, horn form madreporites, encrinites, entrochites, pectinites, anthocephalites, cardites, orthoceratites, turbinites, trilobites, milleporites. The latter are yet white, and have the appearance of branching coral rocks of the ocean.

Localities. Ithaca, south side of Lake Erie, between its eastern termination and Sturgeon Point.

IV. SUPERINCUMBENT CLASS.

Includes those hornblende rocks, which overlay other rocks in a non-conformable position. They are considered by many geologists as of volcanic origin.

XXIV. AMYGDALOID, *(OR BASALT,)*

Is an aggregate of hornblende particles, so minute and so closely compacted as to appear homogeneous to the naked eye. Color dark grey or brown, rarely greenish. It contains vermicular cavities, and sometimes geodes filled with calcareous spar, amethystine quartz, chalcedony, chabasie, analcime. It rests on old red sandstone or saliferous rock.

Localities. Deerfield, Mount Holyoke on Connecticut river.

XXV. GREENSTONE TRAP,

Is an aggregate of hornblende and feldspar and sometimes of quartz. It often exhibits a tendency to a columnar structure. Its color is mostly dark grey, with a greenish tinge on being wet. It is coarser grained than amygdaloid. The grains of feldspar or quartz may be discovered by the naked eye.

Localities. It appears at irregular intervals from the north part of Massachusetts to New-Haven, in Connecticut. It likewise constitutes the Palisadoes on the west bank of the Hudson.

V. ALLUVIAL CLASS.*

Includes those deposits which are made up of ruined strata. They consist principally of clay, sand, pebbles, gravel, peat, bog-iron, calcareous and siliceous tufa, products of volcanoes, &c. This class may properly be divided into three sections.

SECTION I. ANTEDILUVIAL,

Includes those regular strata, which consist of clay, sand and limestone, deposited from the exuviæ of marine animals, at the bottom of the ocean.

XXVI. PLASTIC CLAY,

Consists of an indefinite number of clay, sand and pebble beds, irregularly alternating: the sand predominates. The clay is unctuous and contains

* The formations which properly come into this class, have not as yet received sufficient attention to be designated and placed in either of these sections. But facts are every day collecting which tend to illustrate them more clearly, and furnish data for a correct division into sections.

some siliceous but no calcareous matter, and is absolutely refractory, when not too much iron. Color white, grey, yellow, grey mixed with red. The sands are of a great variety of color.

Mineral contents and organic relics. Coal, which bears decided marks of a vegetable origin, gypsum, fullers earth. Teeth of fish, ostreæ.

The plastic clay in England rests on chalk.

XXVII. MARLY CLAY. PIERCE. (*LONDON CLAY.*)

Consists of a stiff blue or blackish clay, intermixed with some sand, and considerable calcareous matter, so as often to effervesce with an acid. When this clay is sunk into or exposed in a cliff, it is uniformly found to contain layers of ovate flattish masses of argillaceous limestone, which mostly have the appearance of having been traversed by cracks, since partially or wholly filled by calcareous spar or sulphate of barytes. These masses have obtained the name of *septaria.*

Mineral contents and organic relics. Sulphuret of iron, selenite, phosphate of iron, sulphate of magnesia. Crocodile and turtle, vertebral fish, crustaceous fish, as lobsters, crabs, masses of wood, ligneous seed vessels.

Localities. On the banks of the Hudson, at Albany.

XXVIII. BAGSHOT SAND,

Consists of loose porous sand, and often contains indurated masses of sand. Color grey or greyish-brown.

Localities. The barren soil back of Albany is composed of this sand.

SECTION II. DILUVIAL,

Consists of a mantle of sand and gravel, covering indifferently all the solid strata, and which has resulted from causes acting at one and the same time on all the strata subsequent to their consolidation. This stratum contains numerous remains of dry land animals, which perished during the Deluge.

SECTION III. POSTDILUVIAL,

Consists of accumulation of sand and gravel along the sea coast, and in æstuaries, of the formation of new land, assisted by the growth of vegetables; of deposition of calcareous and siliceous tufa, and of the products of volcanoes, or whatever deposits resulting from causes still in operation. It includes the peat-bogs, bog-iron ore, the soil resulting from the disintegration of rocks, &c.

XXIX. GEEST,

Is made up of the fragments of rocks which have disintegrated and remain in situ, or have not been much displaced by currents of water. It generally reposes on its parent rock, and of course, depends on the nature of the rock from which it results.

XXX. VOLCANIC PRODUCTIONS,

Consist of substances which have undergone a partial or total change by the action of subterraneous fires. Real volcanic productions always exhibit internal marks of previous fusion, and sometimes they have been subjected to such intense heat as to become fluid. A few of the varieties of the lava will be described.

1. *Compact Lava.* Structure comparatively *compact*; generally small pores may be discov-

ered by the naked eye. It occupies the lower parts of the current of lava, thus receiving the weight of the superincumbent mass.

2. *Cellular Lava.* It is characterized by numberless pores or small spherical cavities, which it contains, and which are said to be larger near the surface. It passes by imperceptible shades into compact lava. The cavities are usually elongated in the direction of the current. Color some shade of brown, black, grey. Fracture earthy and dull.

3. *Volcanic Scoria.* Resembles the scoria from a forge; it being more altered, vitreous, tumified and expanded than cellular lava. It often contains crystals of schorl, feldspar, brucite, pyroxene and hornblende.

4. *Volcanic Sand.* Consists of hard grains, of various sizes, which appear to be chiefly fragments of scoria. It also contains fragments of lava, crystals of schorl, augite, feldspar, &c. Volcanic sands often cover a great extent of ground, and so deep as to destroy vegetation.

5. *Volcanic Ashes.* Consist of a fine light dusty substance, which is smooth to the touch. Color grey, brownish or reddish. They sometimes contain 50 per cent of alumine. Some mineralogists consider these ashes as very fine volcanic sand; others suppose them to be real ashes, resulting from the combustion of coal.

6. *Puzzolana.* Occurs in small fragments, or friable masses, which have a dull earthy aspect and fracture, and seem to have been baked. Color grey, whitish, reddish or nearly black. It is not so porous as scoria. It yields on analysis about 60 silex, 20 alumine, 15 iron, lime 6. It is useful

in the preparation of a mortar which hardens speedily under water.

7. *Trass* or *Terras*. Color brownish or yellowish; fracture earthy and dull. It is harder than puzzolana, contains more lime, but is very similar to it in nature, and is useful in the preparation of mortar, and was employed for this purpose in the construction of the Eddystone Lighthouse.

EXPLANATION OF TERMS, &c.

COMMONLY USED IN MINERALOGICAL AND GEOLOGICAL DESCRIPTIONS.

ACICULAR. Long and slender like a needle.

AGGREGATE. A rock, composed of two or more simple minerals.

ALLIACEOUS. The odor given out by arsenical minerals, which resembles garlic.

ALLOY. A combination of two or more metals in a metallic state.

AMALGAM. A combination of any two metals, of which mercury is one.

AMORPHOUS. Having no regular determinate form.

ANHYDROUS. Without water, as the anhydrous gypsum.

ARBORESCENT. To grow like a tree.

BASE. A term denoting the substance to which an acid is united.

BLADED. A term applied to those crystals composed of long thin plates, and which have nearly a straight edge.

BOULDER. A term applied to loose masses or fragments of rocks.

CALCAREOUS. A term applied to rocks or minerals composed principally of carbonate of lime.

CAPILLARY. Resembling a hair.

CAVERNOUS. A rock in which there are considerable hollows or cavities.

CONCENTRIC. When a mineral or rock is composed of several curved layers, lying over each other, and having the same centre, the layers are said to be *concentric*.

CONCRETION. A term applied to the small distinct portions of a mineral of various forms.

CORRODED. Containing numerous rough cavities, as if worm eaten.

CUNEIFORM. Having the form of a wedge.

DEBRIS. A term applied to the remains of distintegrated rocks.

DECREPITATION. A mineral, which when exposed to heat, yields a cracking noise, and is dispersed in numerous small fragments, is said to decrepitate.

DENTIFORM. Like a tooth.

DIEDRAL. A crystal terminated by two oblique summits.

DISINTEGRATION. When the particles of a rock separate by the action of air and moisture, it is said to disintegrate.

DRUSES. Cavities lined with crystals.

EFFLORESCENCE. When a mineral loses its water of crystallization and becomes a fine powder, it is said to effloresce.

EPIGENE. A chemical alteration which has taken place subsequent to the formation of a mineral.

FASCICULAR. An epithet applied to a group of minute crystals or fibres somewhat diverging, like a bundle of rods.

FILIFORM. Like a thread.

GANGUE. That portion of a rock, which embraces an ore, or any mineral substance not essential to the composition of the rock.

GEODE. Differs from a druse in being a cavity within a ball, or it may be applied to those cavities in rocks which are more or less spherical.

HÆMATITES. A term which signifies blood-red, it was *first* applied to the variety of iron ore called red *hæmatite*.

HEPATIC. A term applied to those minerals which have either the color or form of the liver.

HEMITROPE. When a crystal is composed of two parts, one of which appears to have turned through half of the circumference of a circle.

HYDRATE. A compound of which water in a solid state forms an essential part.

IMBEDDED. A mineral found in a mass of a rock, or another substance is said to be imbedded in it.

INCRUSTING. Any substance coverved by a mineral is said to be incrusted by it.

LAMINÆ. Thin leaves, plates or layers.

LENTICULAR. Resembling a convex lens.

MACLED CRYSTAL. See Hemitrope.

MAMMILLARY. Presenting a small segment of a large sphere.

MATRIX. The same as Gangue.

MECHANICAL DIVISION. The application of force, by which the laminæ of a mineral are separated, in the direction of their natural joints.

MELLATE. A salt in which mellitic acid is combined with a base.

NATURAL JOINTS. The plane in which any two laminæ of a crystal are united.

NODULAR. A mineral which presents irregular globular elevations is termed *nodular*.

OXIDATE. To cause oxygen to unite with any substance.

OXIDE. Any substance which contains oxygen, if the compound does not possess the properties of an acid. Water, which is composed of hydrogen and oxygen, is an oxide; but this term is usually applied to metals combined with oxygen. When one proportion is combined with a metal it is termed *protox-*

ide; when two, *deutoxide.* The highest oxide of any metal is termed *peroxide.*

OXYGEN. A simple substance, which in most cases is essential to combustion, during which it combines with the combustible. It gives that sourness to acids, and is an essential constituent of them. It constitutes by weight about 22 per cent of air, and 88 per cent, by weight, of water.

OXYGEN GAS. Solid oxygen rendered gaseous by caloric.

PASS INTO. One mineral or rock is said to pass into another, when both are found so blended in the same specimen that it is impossible to decide where one terminates and the other begins.

PLUMOSE. Resembling a feather.

POROUS. A mineral is said to be porous, when it is traversed in different directions with communicating holes which pass through the substance.

PRECIPITATE. Any substance which being previously dissolved in a fluid is thrown down by the addition of any other substance, and gradually falls to the bottom of the vessel.

PSEUDOMORPHOUS. Minerals exhibiting the impressions or forms of other crystals, are said to be pseudomorphous.

PULVERULENT. When the particles of a mineral are very minute and cohere very slightly or not at all, it is said to be pulverulent.

REDUCTION. When a metal, existing in the state of an oxide, or combined with an acid, is brought to a metallic state, it is said to be reduced. This reduction is effected by fusing the oxide alone or by charcoal, which abstracts the oxygen, or by fusing it with fluxes.

RENIFORM. Resembling the kidney in form.

RETICULATED. When fibres or crystals cross each other like the threads of a net.

RADIATED. When the crystals of a mineral are so disposed as to diverge from a centre.

REPLACEMENT. When the edges or solid angles of a crystal are wanting, and in the room of them there is a plane, those edges or solid angles are said to be replaced.

SALT. A compound produced by the union of an acid with an alkali, earth or metallic oxide.

SCOPIFORM. When a mineral exhibits slight diverging fibres like a broom.

SILICEOUS. An epithet applied to those rocks or minerals which are composed principally of silex.

SIMPLE MINERALS. In mineralogy, means those minerals which are of a homogeneous aspect, and is used in contra-distinction to aggregates.

SPECULAR. When a mineral presents a smooth brilliant surface like a mirror.

STRIÆ. When a mineral is marked by minute channels, it is said to be striated.

VESICULAR. When a mineral contains cavities, more or less resembling bubbles of air.

TABLE OF SYNONYMES.

Abrazite, see Zeagonite.
Achirite, see copper carb. siliceous
Actinolite, see Amphibole.
Actinote, see Amphibole.
Adamantine Spar, see Corundum.
Adularia, see Feldspar crystall'd.
Aehrenstein, see Barytes, sulphate
Aequinolite, see Spherulite.
Aerolite, see Iron, native, meteoric.
Aerosite, see Silver, sulphuret, antimonial.
Agalmatolite; Bildstein; Figure stone; Koreite; Lardite; Pagodite.
Agaphite, see Alumine, hydrate, compact.
Agaric Mineral, see Lime, carbonate, spongy.
Agate, see Quartz.
Agustite, see Emerald, var. Beryl.
Akanticone, see Epidote.
Alabaster, see Lime, sulphate.
Alalite, see Pyroxene.
Albin, see Apophyllite.
Albite, see Cleavelandite.
Allagite, see Manganese, carb. siliceous.
Allanite, see Cerium, oxide, ferriferous.
Allochroite, see Garnet.
Allophane, see Alumine, silicate.
Almandine, see Garnet.
Alum, see Alumine, sulphate.
Alumine.
  hydrate.
    crystallized, Diaspore.
    stalactitic, Gibbsite.
    compact, Agaphite; Calaite; Johnite; Turquoise.
  phosphate.
    crystallized, Devonite; Hydrargillite; Lasionite; Wavellite.
  silicate; allophane.
  sub-sulphate; Aluminite; Hallite; Websterite.
  Sulphate of, & Potash; Alum.
Aluminite, see Alumine, sub-sulphate.
Amalgam, see Mercury, argentiferous.
Amausite, see Feldspar, compact.
Amazon-stone, see Feldspar, green
Amber; Bernstein; Karase; Succin.
Amblygonite.
Amethyst, see Quartz.
Amianthinite, see Amphibole, Amianthoide.
Amianthoide, see Amphibole.
Amianthus, see Asbestus.
Ammonia, muriate; Sal-ammoniac sulphate, Mascagnin.
Amphibole.
  The following varieties, according to Brooke, belong to Amphibole:
    Common Hornblende; Keraphyllite & Keratophyllite.
    Carinthin.
    Basaltic Hornblende.
    The foliated Augite of Werner
    The blue Hypersthene of Giesecke.
    The green Diallage of Haüy; Imaragdite; Lotalite.
    Pargasite.
    Actynolite; Actynote; Strahlite.
    Tremolite; Grammatite.
    Amanithoide; Amianthinite; Asbestinite; Byssolite.
Amphigene, see Leucite.
Analcime: Cubicite.
Anatase, see Titanium, oxide.
Andalusite; Micaphyllite; Stanzaite.
Andreasbergolite, see Harmotome
Anhydrite, see Lime, sulph. anhydrous.
Anthophyllite.
Anthracite, see Coal.
Anthracolite, see Coal.
Anthraconite, see Lime, carb. col
Antimony.

oxide; White antimony.
sulphuretted; Red antimony.
earthy; Tinder ore (Leonhard)
sulphuret; Grey antimony.
Apatite, see Lime, phosphate.
Aphrite, see Lime, carb. nacreous
Aphrizite, see Tourmaline.
Apophyllite; Albin; Fish-eye-stone; Ichthyophthalmite.
Aquamarine, see Emerald, Beryl.
Arendalite, see Epidote.
Arfwedsonite; Ferriferous hornblende.
Argentine, see Lime, carb. nacreous.
Arktizite, see Scapolite.
Armenite, said to be Quartz or carbonate of Lime, colored by carbonate of copper.
Arragonite, see Lime, carbonate.
Arsenic.
sulphuret, red Realgar.
yellow, Orpiment.
Asbestinite, see Amphibole.
Asbestoide, see Amphibole.
Asbestus.
flexible, Amianthus.
Asparagus-stone, see Lime, phos.
Asphaltum, see Bitumen.
Astrapyalite, see Quartz, sandtubes
Atacamite, see Copper, muriate.
Atlaserz, see Copper, carb. green.
Atramentstein, see Iron, sulph. decomposed.
Augite, see Pyroxene.
Augustite, see Lime, phosphate.
Automalite, see Zinc, oxide aluminous.
Avanturine, see Quartz, amorph's.
Axe-stone, see Jade.
Axinite, Thumerstone; Thermite; Yanolite.
Azabache, see Coal, Jet.
Azurite; Klaprothite; Tyrolite; Vordulite.

Baikalite, see Pyroxene.
Baldogee, see Green earth.
Bardiglione, see Lime, sulph. anhydrous.
Barytes.
carbonate; Borolite; Witherite.
sulphate; Baroselenite.
radiated; Bolognian-spar; Litheosphore.
compact; Cawk.
acicular, diverging & imbedded in some other substance; Aehrenstein.
Basanite, see Quartz.
Baudescrite, see Magnesia, carb. silic.
Beilstein, see Jade.
Bell-metal ore, see Tin, sulphuret of Copper and Tin.
Bergmanite; Spreüstein.
Bergmehl; Mountain meal.
Bernstein, see Amber.
Beryl, see Emerald.
Berzelite, see Petalite.
Bildstein, see Agalmatolite.
Bimstein, see Pumice.
Bismuth.
sulphuret.
plumbo-cupriferous; Needle-ore.
argentiferous; Bismuthic silver.
Bitter-spar, see Lime, carb. magnesian.
Bitumen.
liquid; Naptha.
viscid; Petroleum.
solid elastic; Elaterite.
compact; Asphaltum.
earthy; Maltha.
fossil copal; Highgate resin.
Blattererz, see Tellurium, native, plumbo-auriferous.
Bleiniere, see Lead, arseniate.
Bleischweif, see Lead, sulph. compact.
Blende, see Zinc, sulphuret.
Blizsinter, see Quartz, sand-tubes.
Bloedit, see Magnesia, sulphate of, and Soda.
Bloodstone, see Quartz, chalced'y
Bohnerz, see Iron, oxide, hydrous.
Bole; Lemnian earth; Terrade siena; Terra sagillata.
Bolide, see Iron, native, meteoric.
Bolognian spar, see Barytes, sulphate.
Boracic acid; Sassolin.
Boracite, see Magnesia, borate.
Borax, see Soda, borate.
Boreah, see Soda, carbonate.

Botryolite, see Lime, borate, siliceous.
Bournonite, see Lead, triple sulphuret.
Brongniartin, see Soda, sulph. of Soda and Lime.
Bronzite ; fibrous Diallage metaloide.
Brown spar, see Iron, carb. and see Pearl spar.
Brucite, see Condrodite.
Brunon, see Titanium, ox. sil. calc.
Byssolite, see Amphibole.

Cacholong, see Quartz, chalcedony
Calaite, see Alumine, hydrate.
Calamine, see Zinc, carb.
Chalcedony, see Quartz.
Cantalite, see Quartz, yel. green.
Carinthin, see Amphibole.
Carnelian, see Quartz, chalcedony
Cascalho, clay indurated by iron and quartz.
Cats eye, see Quartz.
Cawk ; compact sulphate of barytes.
Celestine, see Strontian, sulphate.
Cerauniansinter, see Quartz, sandtubes.
Ceraunite, see Jade, nephrite.
Cerin, see Cerium.
Cerite, see Cerium.
Cerium.
  fluate of Yttria, Cerium and Lime ; Yttrocerite.
  oxide, siliceous, red Cerite, Ochroite, ferrosiliceous, black ; Cerin ; Allanite.
Chalcolite, see Uranium, phosph.
Chalcosiderite, see Iron, green, earthy, fibrous.
Charcoal, mineral, see coal.
Chelmsfordite, see Scapolite.
Chiastolite ; Crucite ; Macle.
Chrysoberyl ; Cimophane.
Chrysocolla, see Copper, carb. siliceous.
Chrysolite, see Peridot.
Chrysoprase, see Quartz, chalcedony.
Chusite, see Peridot, gran. decomposing.
Cinnabar, see Mercury, sulphuret.
Cinnamon-stone ; Essonite ; Hyacinth ; Romanzovit.
Cleavelandite ; Albite ; Siliceous spar.
Coal.
  carbon nearly pure ; Anthracite ; Anthracolite ; Geantrace.
  bituminous.
    compact, cannel coal.
    slaty ; common coal.
    friable ; mineral charcoal.
  ligniform. Wood coal.
    compact ; Azabache ; Jet.
    fibrous ; Bovey coal ; Surturbrand.
    foliated ; Dysodile ; Paper coal.
Cobalt.
Coccolite, see Pyroxene, granular
Cockle of the Cornish miners, see Tourmaline.
Collyrite or Kollyrite.
Colophonite, see Garnet.
Columbite, see Tenantite.
Condrodite or Chondrodite.
Conite, see Lime, carb. magnesian
Copal fossil ; Highgate resin, see Bitumen.
Copper.
  arseniate.
    octaedral ; Linseners.
    prismatic.
      right, crystallized; Olivenit.
      fibrous ; Wood copper.
      rhombic ; copper mica.
  arseniate of cop. & iron ; Skorodite.
  carbonate.
    green ; Malachite.
      fibrous ; Atlaserz.
    Epigene, having the form of the blue carb. or of the red oxide.
  siliceous ; Achirite ; Dioptase.
  hydrate.
    siliceous ; chrysocolla.
  muriate.
    arenaceous ; Atacanite ; green sand of Peru.
  native.
    Combined with Arsenic and iron. White Copper.

oxide.
Earthy ; Tileore.
seleniuret.
of Silver and Copper, Eukairite.
sulphuret ; Glance Copper
of Copper and Iron; Copper pyrites ; yellow Copper ore ; purple Copper ; Bunt kupferez.
of Copper, Iron and Arsenic ; Tenantite.
Corallenerz, see Mercury, sulpt. hepatic.
Cordierite, see Dichroite.
Corundum.
blue ; Sapphire ; Telesie.
red ; oriental ruby ; Telesie.
yellow ; oriental Topaz.
purple ; oriental Amethyst.
common ; Adamantine spar.
ferriferous ; Emery.
Crichtonite, see Titanium.
Crispite, see Titanium, rutile.
Crocalite, see Mesotype, red, globular, radiated.
Crucite, see Chiastolite.
Cubicite, see Analcime.
Cyanite ; Disthene ; Kyanite ; Rhætizite ; Sappare.
Cymophane ; Chrysoberyl.

Datholite, see Lime, borate, siliceous.
Daourite, see Tourmaline, red.
Dapeche, see Bitumen.
Delphinite, see Epidote.
Deodalite, see Pitchstone.
Devonite, see Alumine, phosphate.
Diallage.
green, see Amphibole.
metalloide, foliated, see Schillar spar.
fibrous, see Bronzite.
Dialogite, see Manganese, carb.
Diaspore, see Alumine, hydrate.
Dichroite ; Cordierite ; Iolite ; Peliom ; Steinheilite.
Diopside, see Pyroxene.
Dioptase, see Copper, carb. siliceous.
Dipyre ; Leucolite.
Disthene ; Cyanite.
Dolomite, see Lime, carb. magne.
Dragonite, see Quartz, crystall'd.
Dysodile, see Coal.

Edelite, see Mesotype, red, earthy.
Egeran, see Idocrase.
Egyptian pebble, see Quartz, Jasper.
Eisenkiesel, see Quartz, ferruginous.
Ekebergite, see Scapolite.
Elaolite, see Fettstein.
Elaterite, see Bitumen, elastic.
Electrum, see Gold.
Emerald.
green.
transparent ; precious Emerald.
opake ; common.
blue and yellow of various shades, Beryl.
blue from Siberia ; Agustite.
greenish-blue from Brazil, Aquamarine.
Emery, see Corundum.
Endellione, see Lead, triple sulphuret of Lead, Copper and Antimony.
Epidote ; Akanticone ; Areudalite ; Delphinite ; Illuderite ; Pistazite ; Thallite.
granular, Scorza.
Ercinite, see Harmotome.
Esmarkite, see Lime, borate, siliceous.
Essonite, see Cinnamon stone.
Euchysiderite, see Pyroxene, fusible.
Eukairite, see Copper, seleniuret.

Fassaite, see Pyroxene.
Feldspar, Orthose.
crystallized.
transparent or translucent.
Adularia.
with bluish opalescence ; Moon-stone.
glassy ; Sanidin.
opake.
green ; Amazon-stone.
variously opalescent, Labrador feldspar.

fetid ; Necronite.
compact ; Amausite ; Felsite ; Felstein ; Hornstone.
fusible ; Lemanite ; Sodalite ; Saussurite.
globular. Giving its peculiar character to the rock called Napoleonite, and to another called Variolite.
decomposed ; Kaolin.
Felstein, see Feldspar, compact.
Fettstein ; Elaolite ; Sodalite.
bluefrom Laurwigin Norway, see Glaucolite.
Figure stone, see Agalmatolite.
Fiorite, see Quartz.
Fish eye-stone, see Apophyllite.
Flint, see Quartz.
Flockernerz, see Lead, arseniate.
Flos-ferri, see Lime ; Arragonite, coralloidal.
Fluor spar, see Lime, fluate.
Fossil copal, see Bitumen.
Franklinite, see Iron, oxide.
Frugardit, reddish Idocrase containing Magnesia.
Fulgurite, see Quartz, sand-tubes.

Gahnite, see Zinc, oxide, aluminous.
Galena, see Lead, sulphuret.
Gallizenstein, see Zinc, sulphate.
Gallizinit, see Titanium, rutile.
Garnet crystallized.
black Melanite.
from Pyrenees, Pyreneite,
greenish from Baikal ; Grossularia.
yellow ; Topazolite.
granular.
red Pyrope.
yellow Succinite.
brownish-yellow, Colophonite.
amorphous.
transparent ; prec. Garnet ; Almandine ; Greenlandite.
opake and greenish, Allochrolte.
Geantrace, see Coal.
Gehlenite ; Stylobat.
Geyserite, see Quartz.
Girasol, see Quartz, opal.
Gesmondin, see Zeugonite.
Glance Copper, see Copper, sulphuret.
Glauberite, see Soda, sulph. Soda and Lime.
Gold, native.
argentiferous ; Electrum.
Gothite, see Iron, ox. hyd.
Grammatite, see Amphibole.
Grammite, see Lime, silicate.
Graphic ore, see Tellurium.
Graphite ; Plumbagine ; Plumbago.
Grenatite, see Staurotide.
Green earth ; Baldogee.
Greenlandite, see Garnet.
Gregorite, see Titanium oxide, ferriferous.
Grossularia, see Garnet.
Gummistein, see Quartz, hyalite.
Gurhofian, see Lime, carb. magn. compact.
Gypsum, see Lime, sulphate.

Hallite, see Alumine, sub-sulph.
Hallotrichum, see Magnesia, sulphate.
Harmotome ; Andreasbergolite ; Andreolite ; Ercinite.
Haüyene ; Latialite.
Heliotrope, see Quartz, Chalcedony.
Helvin, see Manganese silicate.
Hepatite, see Barytes.
Heulandite ; foliated Stilbite.
Highgate resin, see Bitumen.
Hoganite, see Mesotype.
Honey-stone, see Mellite.
Hornblende, see Amphibole.
ferriferous, from Greenland, Arfwedsonite.
Hornstone, fus. see Feldspar com. infusible, see Quartz.
Humboldtite, see Lime sil. borate.
Hyacinth, sometimes applied to a red var. of Zircon, and sometimes to Cinnamonstone.
Hyalite, see Quartz.
Hydrargillite, see Allumine phos.
Hydrophane, see Quartz opal.
Hydropite, see Manganese silicate
Hypersthene, blue, from Greenland, see Amphibole.
from Labrador ; Paulite.

Leucolite ; Dipyre.
Lievrite ; Yenite.
Lillalite, see Lepidolite.
Lime.
arseniate ; Pharmacolite.
borate, siliceous.
crystallized ; Datholite; Esmarkite.
from the Tyrol ; Humboldite.
botryoidal ; Botryolite.
carbonate.
nacreous ; Scheiffer spar.
laminar ; Aphrites.
columnar ; Madreporite.
slaty containing shells, Lumachella.
globular ; Oolite.
earthy: Chalk.
spongey ; Agaric mineral.
pulverulent ; Fossilfarina.
stalactitic ; Inolite.
globular; Pisolite.
incrusting ; Tufa. Ostrecolla.
sedimentary ; Travertino.
arragonite ; Igloite.
corralloidal ; Flosferri.
magnesian, carb. Anthraconite ; Bitter ; Miemite; Murecalcite ; Pearl spar ; Pierite ; Tharandite.
granular ; Dolomite.
compact ; Conite ; Gurhofian.
magn. Limestone.
aluminous ; Marl.
fluate.
earthy ; Roctoffkite.
Chlorophane.
phosphate ; Apatite ; Augustite.
in yellow crystals ; Asparagus stone.
bluish ; Moroxite.
fibrous ; Phosphorite.
pulverulent ; Terre de Marmarosch.
silicate ; Schaalstein ; Grammite.
tabular spar ; Wollastonite.
sulphate ; Gypsum.
crystallized : selenite.
scaly, niviform Gypsum.
sulphate.
compact ; Alabaster.
calcareous ; Plaster stone.
anhydrous ; Anhydrite ; Bardiglione ; Karstenite ; Muriacite.
fibrous and contorted, pierre de trippes.
quartziferous ; Vulpinite.
scheelate ; Tungsten.
Limonite, see Iron, oxide.
Linsenerz ; Copper, arseniate.
Lipalite, see Quartz, flint.
Litheosphore, see Barytes, sulph. radiated.
Liver ore, see Mercury.
Lodalite, see Feldspar, compact.
Loloite, see Idocrase.
Lotalite, see Amphibole, green Diallage.
Lumachella, see Lime, carb.
Lydian stone, see Quartz.

Macle ; Chiastolite.
Maclurite ; Brucite.
Madreporite, see Lime, carbonate
Magnesia.
borate, Boracite.
siliceous, compact ; Baudisoerite ; Magnesite.
pulverulent ; Razoumoffskin.
hydrate, siliceous ; Meerschaum ; Myresen ; Kil ; Killkeffe.
of Magnesia and Soda, Bloedit.
sulphate.
mag. & iron ; Hallotricum.
Magnetic iron, see Iron, oxydulous.
Malachite, see Copper, carbonate.
Malacolite, see Pyroxene.
Maltha, see Bitumen.
Manganese.
carbonate.
foliated ; Dialogite.
compact ; Rhodochrosite.
siliceous.
anhydrous ; Allagite ; Photizite.
hydrous ; Rhondonite.
oxide.
earthy ; Wad.

silicate ; Red manganese ore.
compact ; Hydropite.
Marckanite ; Obsidian.
Markasite, see Iron, sulph. arsen'l
Mascagnin, see Ammonia, sulph.
Melanite, see Garnet, black.
Melanteria, see Iron, sulphate.
Mellite ; Honey stone.
Menachanite, see Titanium, oxide
Menilite, see Quartz, opal.
Mercury.
native.
argentiferous, Native amalgam.
sulphuret ; cinnabar.
hepatic ; Korallenerz ; Liver ore.
Mesotype.
red, globular radiated ; Crocalite.
earthy ; Edelite.
yellow or reddish-white : Hoganite
iratrolite.
Meteorite, see iron, native.
Micaphyllite ; Andalusite.
Micarelle ; Pinite or Scapolite.
Miemite, see Lime, carb. magne'n
Mispickel ; arsenical sulph. of Iron
Mocha-stone, see Quartz, Agate, dendritic.
Molarite ; Buhrstone.
Moon-stone, see Feldspar.
Moroxite, see Lime, phosphate.
Mountain meal, see Bergmehl.
Mülersglass ; hyalite.
Mureacite, see Lime, sulp. anhyd.
Murealcite, see Lime, carb. mag'n
Mundic ; Iron pyrites.
Mussite, see Pyroxene.
Myrsen, see magn. hydrate Silver.

Naptha, see Bitumen.
Napoleonite, see Feldspar, glob'lr
Napolite, a blue min. from Vesuvius
Natrolite, see Mesotype.
Natron, see Soda.
Necronite ; fetid Feldspar.
Needle ore, see Bismuth, sulphuret
Needle-stone ; Scolezite.
Neopetre, see Quartz, hornstone.
Nepheline ; Sommite.
Nephrite, see Jade.
Nigrine, see Titanium.
Nosin, see Spinnellane.
Novaculite ; Turkey-stone.

Obsidian ; Volcanic glass.
in small rolled fragments ; Marckanite.
Ochroite, see Cerium, oxide.
Octaedrite, see Cerium, oxide.
Oisanite, see Titanium, ox. Anatase
Oligiste iron, see Iron, oxide.
Olivenite, see copper, arseniate.
Olivine ; Peridot.
Omphazite, a mixture of Garnet and green Diallage, and probably Cyanite. Brooke.
Oolite, see carbonate of Lime.
Opal, see Quartz.
Ophite, see Serpentine.
Orpiment ; yellow sulph. Arsenic.
Otrelite, see Schiller spar.

Pagodite, see Agalmatolite.
Paranthine, see Scapolite.
Pargasite, see Amphibole.
Paulite ; Hypersthene.
Pearl spar, see Lime, carb. mag'n
Pechuran, see Uranium, ox. ferrif.
Peliom, see Dichroite.
Pentaclasite, see Pyroxene.
Peridot ; Crysolite.
granular, Olivine.
Petalite ; Berzelite.
Petroleum, see Bitumen.
Petro-silex, sometimes compact feldspar, and sometimes a compact variety of Quartz.
Petuntz, see Feldspar, decomp'ng
Pharmacolite, see Lime, arseniate
Phengite, referred to Anhydrite & Topaz, (Leonhard.)
Phosphorite, see Lime phos. fibro's
Photigite, see Manganese, carb. siliceous.
Phrysalite, see Topaz.
Picolite, see Tourmaline.
Picrolite, a fibrous, radiating substance, found in Serpentine, at Taberg in Sweden.
Picrite, see Lime, carb. magnesia.
Pictite, see Turnerite.
Pimelite, clay col. with ox. Nickel.
Pisolite, see Lime carb.
Pistazite, see Epidote.

Pitchblende, see Uranium, ox. fer.
Pitchstone ; Deodalite ; Pyraphonite ; Retinite.
Pittizite, see Iron, sub. sulphate.
Plasma, see Quartz, Chalcedony.
Pleonaste, see Spinelle.
Plombagine, see Graphite.
Plombgomme, see Lead, phos.
Porcellain, see Quartz, Jasper.
Potash ; Kali.
  nitrate ; Nitre.
Potstone, see Talc, compact.
Pounxa, see Soda, borate.
Prase, see Quartz.
Prehnite ; Koupholite.
Pumice ; Bimstein.
Pyraphrolite : Pitchstone.
Pyrenaite, see Garnet, black.
Pyrgom, see Pyroxene.
Pyrodmalite : Pyromalite.
Pyromorphite, see Lead, phos.
Pyrope, see Garnet.
Pyrophysalite, see Topaz.
Pyrosiderite, see Iron, ox. hyd.
Pyrosmalite, see Pyrodmalite.
Pyroxene.
  crystallized : Alalite : Augite : Baikalite : Diopside : Fassaite : Malacolite : Mussite : Pentaclasite : Pyrgom: Sahlite : Vulcanite : Bournon's yellow Topaz : The green prisms accompanying the Yenite from Elba.
  granular, Coccolite.
  fusible, Enchysiderite.
Quartz.
  crystallized.
    colorless, rock crystal; Dragonite.
    red, Compostella quartz ; Ferruginous quartz.
    yellow.
      opake ferriforous, Eisenkiesel.
    violet, Amethyst.
    green, Prase.
    granular.
      yellowish-green ; Cantalite.
    earthy, mixed with other substances.
      slaty, Polishing slate.
      compact, Tripoli, Rotten-stone.
  amorphous, common.
    blue, Siderite.
  penetrated by Asbestus : Cat's eye.
  black opake ; Basanite ; Lydian stone.
  jasper, common.
    red, Sinople.
    porcellain jasper.
  agate.
    chalcedony,
      pale-green, colored by Nickel; Chrysoprase.
      dark-green ; Plasma.
        with red dots; Bloodstone.
    Heliotrope.
  carnelian.
    brown ; Sardonyx.
  spheroidal, with concentric layers or bands ; Agate.
  in parallel layers ; Onyx.
  dentritic Moss agate ; Mocha stone.
  mixed with clay ; Jasper.
    Egyptian pebble.
  carious Quartz ; Buhrstone.
    Molarite.
  hornstone, infusible ; Keratite ; Neopetre.
  opal.
    color smoke brown ; Menilite.
  hyalite ; Gummistein ; Müllers-glass.
  recent deposit from hot springs ; Siliceous Sinter ; Geyserite.
    Azorite, from St. Michaels.
  sand tubes ; Astrapyalite ; Blizsinter ; Ceraunian sinter ; Fulgurite.
Rapidolite, see Scapolite.
Ratofkite, see Lime, fluate, earthy
Razoumoffskin, see Magnesia, carb. silex.
Realgar, see Arsenic, sulphuret.
Retinasphaltum, see Bitumen.
Retinite, see Pitchstone.
Reussite, see Soda, sulph. of zinc Magnesia.
Rhetizite, see Cyanite.
Rhodochrosite, see Manga. carb.
Rhodonite, see Mang. carb. silíceous.

Romanzovite, see Idocrase.
Rotten stone, see Quartz, earthy.
Rubellite, see Tourmaline.
Rubin glimmer, see Iron, ox. hyd.
Ruby, see Spinelle.
  oriental, see Corundum.
Rutile, see Titanium, ox.

Sagenite, see Titanium ox. Rutile.
Sahlite, see Pyroxene.
Sal-ammoniac; Muriate of Ammonia.
Sanidin, see Feldspar.
Sappar, see Cyanite.
Sapphire, see Corundum.
Sarcolite, see Analcime.
Sardonyx, see Quartz, agate.
Sassolin, see Boracic acid.
Saussurite, see Feldspar, compact.
Scapolite; Arktizite; Chelmsfordite; Ekebergite; Paranthine; Rapidolite; Wernerite.
Schaalstein, see Lime, silicate.
Scheelium; Tungsten.
Schieffer spar, see Lime, carb. nacreous
Schiller spar; Diallage metalloide, foliated; Karstin; Otrelite.
Schorl, see Tourmaline.
Scorza, granular Epidote.
Selenite, see Lime, sulphate.
Selenium, see Copper, seleniuret.
Semeline, see Titanium, ox. sil. calc.
Serpentine.
  precious, Ophite.
Siberite, see Tourmaline, red.
Siderite, blue Quartz; of Kerwan, phosphate of Iron.
Silicious spar, see Cleavelandite.
Silver.
  sulphuret of Silver and Antimony, red Silver.
  impure or decomposed, blk. Silver
  scaly from Colivan, in Siberia; Acroscite.
  of Silver, Antim. and Iron; brittle Silver.
Sinople, see Jasper.
Skolezite, see Needle stone.
Skorodite; Copper; Arseniate of Copper and Iron.
Skorza; granular Epidote.
Smaragdite, see Amphibole.
Soda; Natron.
  borate; Borax; Pounxa; Swaga; Zala; Tincal.
  carbonate; Borech.
  sulphate.
  earthy.
  of Soda & Lime; Brongniartin; Glauberite.
  of Soda and Magnesia; Reussite.
Sodaite, see Fettstein.
Sommite, see Nepheline.
Speckstein, see Steatite.
Specular iron, see Iron. ox. anhyd.
Spherolite; Acquinolite.
Sphero-siderite, see Iron, carb.
Sphene, see Titanium, ox. sil. calc.
Spinellane; Nosin.
Spinelle; Ruby.
Spinelline, see Titanium, ox. silc. calc.
Spinthine, see Titanium, ox. silc. calc.
Spodumen; Tripham.
Spreüstein, see Bergmanite.
Stahstein, see Iron, carb.
Stanzaite, see Andalusite.
Staurolite, see Staurotide.
Staurotide; Staurolite; Grenatite.
Steatite; Speckstein.
Steinheilite, see Dichroite.
Steinmark; Lithomarge.
Stilbite.
  foliated; Heulandite.
Stilpnosiderite, see Iron, ox. hyd.
Stralite, see Amphibole.
Stromnite, see Strontian, carb.
Strontian.
  carb barytiferous; Stromnite.
Stylobat see Gehlenite.
Succin; Amber.
Succinite; yellow granl. Garnet.
Surturbrand, see Coal.
Swaga, see Soda, borate.
Sylvan, see Tellurium.

Tabular spar, see Lime, silc.
Tantalite; Columbite.
Telesie, see Corundum.
Tellurium, Sylvan ore.
  native.
  auro-argent; Graphic ore.

auro-plumb ; white Tellurium.
native plumbot.
auriferous ; Blattererz ; fol. Tellurium.
Tennantite, see Copper, sulph. of Copper, Iron and Arsenic.
Terra de Siena, see Bole.
Terra sagillata, see Bole.
Thallite, see Epidote.
Tharaudite, see Lime, carb. mag.
Thumerstone, see Axinite.
Thumite, see Axinite.
Tin.
oxide.
fibrous, Wood tin.
sulph. of tin and copper, Bell metal ore.
Tinder ore, see Antimony.
Tincal, see Soda, borate.
Titanium.
oxide ; Anatase ; Octaedrite ; Oisanite ; Rutile ; Crispite ; Gallizinite ; Saginite.
ferriferous; Gregorite, Iserine ; Menachanite ; Nigrine.
silico-calcareous ; Semeline ; Sphene ; Spinthere ; Spinelline.
Topaz ; Physolite ; Pycnite ; Pyrophysalite.
Topazolite, see Garnet, yellow.
Torberite, see Uranium, phosphate
Touch stone ; Basanite ; Lydian-stone
Tourmaline ; Electric schorl.
black, from the Hartz ; Aphrizite.
blue, Indicolite.
red to purple, and sometimes colorless.
Apyrite ; Daurite ; Rubelite ; Siberite.
acicular crystals from Pyrenees ; Picolite.
Travertino, see Lime, carbonate, sedimentary.
Tremolite, see Amphibole.
Triklasite ; Tablienite : Gieseckite
Trephano ; Spodumene.
Tripoli, see Quartz, earthy.
Tungsten ; Scheelium.
Turkey ; Novaculite.
Turquoise, see Alumine, hydrate.
Turnerite ; Pictite.
Tyrolite, see Azurite.

Umber ; hydrous oxide of iron.
Uranite, see Uranium, phosphate
Uranium.
oxide, ferriferous, Pechuran Pitch blende : Uran. Pitch ore
phosphate ; Chalcolite ; Torberite : Uranite.

Variolite, see Feldspar, globular.
Vanquelinite, see Lead, chromate of Lead and Copper.
Vesuvian ; Idocrase.
Vivianite ; Iron, phosphate.
Volcanic glass, see Obsidian.
Voraulite, see Azurite.
Vulcanite, see Pyroxene.
Vulpinite, see Lime, sulph. anhyd.

Wad ; earthy, oxide Manganese.
Wallerite, see Lenzinite.
Wavellite, see Alumine, phosphate
Websterite, see Alumine, sub-sulp.
Wernerite, see Scapolite.
Wilecite, see Idocrase.
Wilherite, carb. Barytes.
Wolfram ; Tungstate of iron and manganese.
Wollastonite, see Lime, silicate.

Yanolite, see Axinite.

Zala, see Soda, borate.
Zeagonite ; Abrazite ; Gismondin
Zeolite Analcime ; Chabaric ; Heulandite ; Natrolite ; Needle-stone ; Stilbite.
Zinc.
oxide.
alluminous; Automelite; Gahnite.
sulphate ; Gallizenstein.
sulphuret ; Blende.
Zircon ; Hyacinth ; Jargon.
Zurlite or Zurlonite.

INDEX.

ADDENDA.

After this work had gone through the press, excepting this last sheet, Professor EATON and his Pupils, accompanied by Professor RAFINESQUE, returned from a tour through the whole line of the Great Erie Canal. On the authority of Professors E. & R. the following additions are made.

Page 203, after the 8th line, add: The *plastic clay* formation has not hitherto been discovered in the interior of New-York or of New-England. Beds of plastic clay are found near Crown-Point, and in a few other localities on the west shore of Lake Champlain; but it has not yet been discovered in the form of a stratum, distinct from Marly Clay.

Same page, after 7th line from the bottom, add: the *marly clay* formation is an universal stratum in New-York and New-England.

Same page, after the bottom line, add: The *bagshot sand* formation is very extensive in New-York and in New-England; but it is very often found passing directly into the Crag, while at the same level and resting on the same supporting base. From the views which Prof. E. & R. have taken of this across the country from Connecticut river to Lake Erie, they are inclined to consider the *bagshot sand* and *crag* as the same general stratum. The *crag* in New-York and in New-England consists of coarse gravel, often intermixed with blue clay and sand, and not unfrequently containing regular horizontal layers on extensive beds of pudding stone, and very large boulders of primitive rocks.

Prof. E. & R. add further, that scarcely any fossil remains have been discovered in the antidiluvium of the district of country which they have examined.

ERRATA.

Page 56, for Pyrosmatite read Pyrosmalite.
—— 101, for Crysolite read Cryolite.
—— 126, for Apohyllite read Apophyllite.

BOOKS

PUBLISHED BY WEBSTERS & SKINNERS,

AND FOR SALE AT THEIR BOOKSTORE, CORNER OF STATE AND PEARL STREETS, ALBANY.

Medical Jurisprudence.

Just published, in 2 vols. 8vo. price in boards $5, "ELEMENTS OF MEDICAL JURISPRUDENCE—By *Theodric Romeyn Beck*, M. D. Professor of the Institutes of Medicine and Lecturer on Medical Jurisprudence in the College of Physicians and Surgeons of the Western District of the State of New-York, &c. &c.

"*Property, Reputation, Life, often rest on the professional evidence of Medical Persons.*—Lon. Med. Rep.

The following notices of this work by distinguished individuals, and the principal Medical Journals, both in Europe and America, will enable the reader to form an opinion concerning the high estimation in which it is held.

Extract of a letter, addressed to the author, by the HON. DE WITT CLINTON.

Albany, 27th Sept. 1823.

"Dear Sir—I have read with equal pleasure and instruction, your *Medical Jurisprudence*. Its methodical arrangement, extensive information, comprehensive views, and luminous illustrations, must render it a standard work of high authority and general reference; and it is not too much to say, that as long as Medicine and Jurisprudence are held in estimation, your felicitous elucidations of their intimate and important connexion, will be considered with the highest respect."

From the Philadelphia National Gazette, edited by Robert Walsh, Esquire.

"This work is in two volumes octavo, and forms the most comprehensive treatise extant on its subject. It is the fruit of indefatigable investigation, pursued for several years past, in the course of which, the learned and able author was furnished from abroad with the best attainable aids for the thorough execution of his task. We have no doubt that the European critics will give him and his country credit for having produced, in this instance, the fullest and most instructive exposition of an extensive and very important branch of knowledge.

"Dr. Beck remarks, in his preface, that although the work is designed primarily for the benefit of physicians, it may be found useful to the gentlemen of the *Bar*. We should suppose, from even a slight examination of its contents, that it might be said to be equally useful to the latter, and in fact indispensable to both."

From the New-York Medical and Physical Journal, No. 9.

"The subject matter of these pages embraces topics of deservedly great interest. They are the result of long and severe study, and that too by one zealously devoted to the cultivation of this branch of science. We believe the work to contain a more ample exposition of the subjects of which it treats, than any other that has heretofore appeared in our language."

From the Philadelphia Journal of the Medical and Physical Sciences, edited by Professor Chapman, No. 13.

"The expectations excited by the annunciation of the work, we think, have been fully realized. It is, in our deliberate opinion, the most valuable production on the subject, honorable to the medical literature of the country, and may be studied with advantage by the physician, lawyer, and general reader."

From the New-York Medical Repository, for February, 1824.

"The volumes now before us are a most triumphant proof of the industry and extensive research of the author. Hardly any work of any eminence the most remotely bearing on the subject, has escaped his notice; and considering the multifarious nature of his subject, it is rather a matter of surprise that he has been able to accomplish so much. Perhaps it requires not the spirit of prophecy to predict that it will take its rank with the best productions of the kind, both in Europe and in this country. To the medical profession it must prove an invaluable text-book, as containing a copious collection of facts connected with the most important enquiries in physiology, and to the legal practitioner an equally valuable exposition of opinions and decisions in those cases of judicial enquiry in which the testimony of experienced physicians is indispensible."

"From the comparatively recent growth of this branch of the science among us, we are agreeably disappointed at finding that so much has been done in the first work professedly devoted to the subject from our press. Accustomed as we have been to look to Europe, and especially to England for our supplies of books of this kind, it is with no small satisfaction that we greet the appearance of an American work, in all respects as well executed as any thing we could import."

From the Edinburgh Medical and Physical Journal.

"At length the English language may boast, that it is possessed of a general work on Medical Jurisprudence, which will not only stand comparison with the best of the kind that the continent has produced, but which may also be referred to by every medical jurist as a monument worthy of his science, and as a criterion by which he is willing that its interest and utility should be tried. Under the unassuming title of Elements of Medical Jurisprudence, Dr. Beck has presented us with a comprehensive system, which embraces almost every valuable fact or doctrine relating to it.—Each of its diversified departments has been investigated so minutely, that few cases can occur in practice, on which it will be necessary to seek elsewhere for farther information. At the same

time, by studying succinctness, and shunning those verbose oratorical details with which other writers, and particularly those of France abound, he has succeeded in rendering his treatise comprehensive within a singularly moderate compass. We may securely assert, that a work on the subject is not to be found in any language, which displays so much patient and discriminating research, with so little of the mere ostentation of learning. The opinions expressed both on general principles and on the particular questions which have occurred in courts of law, are given clearly and judiciously. There are few occasions, even where the points at issue are difficult and obscure, on which persons of skill and experience will be disposed to differ materially with him. In addition to these remarks on the general merits of the book, we have only farther to add, that, in conformity with the laudable custom of the German writers, he has supplied, throughout the whole of it, a most copious list of references to authorities; the want of which in other English works must have been severely felt by every student."

From Dunlop's Preface to the London edition of this work.

"We do not claim for the present work the meed of a faultless performance; but we fear not to challenge a comparison of it with any of the English works in scientific accuracy, philosophical plainness and precision of style, extent of research, genuine scholarship and erudition, pointedness of illustration and copiousness of detail and reference to original documents. We may say, with Dr. Andrew Duncan, jun. in his excellent review of the first edition, that "under the unassuming title of Medical Jurisprudence, Dr. Beck has presented us with a comprehensive system, which embraces almost every valuable fact or doctrine relating to it. Each of its diversified departments has been investigated so minutely, that few cases can occur in practice on which it will be necessary to seek elsewhere for farther information."—Dr. Male also, the father of English Medical Jurisprudence, has the highest opinion of the book, and says, "Dr. Beck has recently published one of the best works on Juridical Medicine which has been compiled either in this or any other country." Supported by such unqualified opinions of its excellence, from two of the best judges on the subject in the empire, Dr. Duncan and Dr. Male, we submit it, with confident hopes of its success, to the practitioners and students of medicine and law."

From Anderson's Quarterly Journal of Medicine and Surgery, (published in London.)

"We congratulate our readers upon the appearance of this admirable work in an English edition, which may be considered superior, in some respects, to the American one, from being enriched with many valuable notes by Mr. Dunlop, the well known lecturer on Medical Jurisprudence. Of a work which has embodied in itself almost all that was previously worth knowing on the subject; a work so elaborate in its execution, and so copious in its references, we cannot speak too highly; and we advise every member of the profession to add it to his library."

From Johnson's Medico-Chirurgical Review, (published in London.)

"This is really a very valuable compilation, and does great credit to the judgment and research of the author."

Manual of Botany,

For the Northern and Middle States of America. Containing generic and specific descriptions of the indigenous Plants and common cultivated Exotics, growing north of Virginia. To which is prefixed, a GRAMMAR and VOCABULARY; Also, the Natural Orders of Linneus and of Jussieu, with the Medicinal Properties of each order. By AMOS EATON, A. M. Professor of Botany, Chemistry, &c. &c.—with an Appendix, by Dr. L. C. BECK. Fourth Edition—Price $2 25.

Since this work has become a common school book, it was deemed advisable to prefix to this edition a concise Grammar of Botany, and a Vocabulary of technical terms, so as to enable students to pursue the study of Botany without the aid of any other book. This addition will increase the expense but little, and save considerable to the purchaser.

Preface to the Appendix.—Since this edition of the Manual has passed through the press, Dr. JohnTorrey of New-York has commenced the publication of his Flora of the Northern and Middle States. The first number of this work has appeared, and it contains descriptions of many plants which are either new, or not contained in the Manual. The reputation of Dr. Torrey as a botanist is so deservedly eminent, that there is no doubt his Flora will become a standard work. The publishers of the Manual, having a desire to render it as complete as possible, requested me to prepare an appendix, containing descriptions of those plants noticed by Dr. Torrey, not contained in this work. This I have accordingly done. I have also added several new species of Lichens from a paper by Mr. A. Halsey, in the first number of the Annals of the New-York Lyceum. Several other additions have been made, consisting of new localities of interesting plants, synonyms, &c. &c.

L. C. B.

Botanical Exercises,

Including Directions, Rules and descriptions, calculated to aid Pupils in the Analysis of Plants; with a Labelling Catalogue, for the assistance of Teachers—By AMOS EATON, A. M.

To Teachers of Botany.—After giving courses of instruction in Botany to more than one thousand pupils, and after having made various attempts at simplifying the method of acquiring a knowledge of this elegant and useful science; I perceive that there still remains one very great obstacle to its progress. Although the expence of necessary books for pursuing this study in the northern and middle states is reduced to about three dollars; yet our economical agriculturalists and mechanics are, and ought to be,

unwilling to pay for three or four sets of such books for the use of as many children.

With a view to obviate this difficulty, I suggested to one of my students that, as we exercise our pupils with but a small portion of the plants embraced in each class, a very cheap book might be compiled from the Manual of Botany and the Botanical Dictionary, which should contain descriptions of as many plants as we analyze in the most extensive courses. He immediately set about the work; but soon discovered, that no subject relating to Botany required so much experience as that of making a proper selection of materials for the exercises of students. I have now gone through with the labor myself, and here present you with the result. The teacher will of course have other books, and many of his pupils will also provide themselves with complete systems. But with this book in the hands of each student, one set of larger books in a large family, or even five or six to a school of twenty or thirty students, will enable teachers to give instruction to as good effect, as though each student possessed a complete Botanical Library.

Chemical Instructor,

Presenting a familiar method of teaching Chemical Principles and Operations of the most practical utility to Farmers, Mechanics, Housekeepers and Physicians; and most interesting to Clergymen and Lawyers. Intended for Schools and the Popular Class Room—Second edition, considerably altered. By Amos Eaton, A. M. Price 87 1-2 cents.

Extract from the Preface.—"I believe it is known to all within the narrow limit of circulation, to which this book is destined, that I have devoted a large proportion of my time and attention to the simplification of chemical experiments, for the last nine years. During this period, I have given more than thirty full courses of lectures on chemistry, with from six to eight hundred experiments at each course; and have endeavoured to improve my method at ever step in each course.

Every change which the reader will find in this edition, is the result of experience. All the experiments are described precisely as I have frequently performed them; and as I have often caused them to be performed by students in my presence.

The whole object of my course of instruction being the practical application of science to the common concerns of life, I give no experiments on rare, doubtful, or useless substances; and avoid, as far as possible, all hypothesis of a merely speculative kind."

Philosophical Instructor,

Or Webster's Elements of Natural Philosophy, subdivided into Principles and Illustrations. Intended for Academies, Medical Schools, and the Popular Class-Room. By Amos Eaton, A. M. Price $1 50.

Webster's Elements of Natural Philosophy were written in the true character of a well proportioned abridgment. He seems to have written his little treatise from a recollection of principles, previously digested and made completely his own.

It should be the object of a concise elementary system of natural philosophy to present a clear view of all the important phenomena appertaining to this department of human knowledge, with such explanations and general solutions as the present state of the science will afford. But those easy applications, which cannot escape any ordinary mind, ought not to encumber such a work, but should be left for teachers and students to supply. Such is Webster's Elements.

Professor Patterson's American edition of this work, published in 1808, is out of print. Had his edition still been in the booksellers' shops, I should not have undertaken this; though I can but hope, that both teacher and pupil will derive considerable advantage from my subdivisions into Principles, Illustrations, and Remarks.

My alterations, though numerous, appeared to me essential, according to the plan of this edition. Besides the alterations, I have added every important improvement and discovery in the science, which comports with the object of the work.

This treatise in its present state is perfectly adapted, in my opinion, to the wants of the medical student, who has not been liberally educated. The hurried courses now given at all the medical schools in America, allow but little time for natural philosophy. The student will find, that Webster has presented him with a concise and well digested exposition of every essential principle of the science.—*Editor's Preface.*

Blake's Practice,

Of the Court of Chancery, of the State of New-York, 2d edition, modified, corrected and improved, in conformity to the present Constitution and Laws. To which is added, the Practice of the several District Equity Courts.

Of the merits of this Book, it is deemed unnecessary to offer any other evidence, than the very rapid sale which the first edition has met with—the letters addressed to the author on a former occasion in relation to it, and the certificate of the Judges of the Circuit Courts of Equity, of which the following are copies:

A letter from the late Honorable Brockholst Livingston, an associate Judge of the Supreme Court of the U. S. to the Author.

August 6th, 1818.

Dear Sir,

I thank you for the valuable present which you made to me, of your Chancery Practice. Miserable as the profession is burthened with thousands of volumes on legal subjects which ought never to have seen the light, but which unfortunately are increasing every hour, a book of equity jurisdiction and practice, was certainly wanting in this state; and the gentlemen of the bar have

reason to rejoice that its execution was undertaken by one so very competent to the task. Every page bears evidence of the talent, diligence and fidelity which have been employed on it; and I will venture to predict, that so long as this work shall be published without note or comment, it will not only remain a monument of the great industry, skill and research which produced it, but that it will much diminish the labour, as well as the expense of the profession, by the entire exclusion of treatises on similar subjects from the other side of the Atlantic, which are now not only unnecessary, but useless.

I am, sir, with great respect, your most obedient servant,

B. LIVINGSTON.

A letter from Chancellor Kent, to the same.

Albany, August 21, 1818.

Dear Sir,

Permit me to thank you for your valuable Treatise on the Practice of my Court. I have perused the whole, and it is superior in utility to any work of the kind; and I think you have done credit to yourself, as well as discharged a duty to the profession. I hope you may hereafter meet with that success in business, and in your professional studies, which your virtues and character promise and demand.

You have my warmest wishes for your welfare, and believe me to be, with great respect and esteem, your obedient servant,

JAMES KENT.

At the request of D. T. BLAKE, one of the masters of chancery for the state of New-York, having lately examined a book, entitled, "*A Treatise on the Practice of the Court of Chancery of the State of New York*," we have no hesitation in saying, that as a book of practice, it will be found of great utility not only in this, but in every other state in the Union which has chancery jurisdiction.

JOHN WELLS,
THOMAS ADDIS EMMET.

New-York, May 5th, 1818.

A certificate of the Honorable the Circuit Judges of the State of New-York.

We the Subscribers, Judges of the Circuit Courts of the State of New-York, concur in the opinions above expressed, in relation to Mr. Blake's System of Chancery Practice.

OGDEN EDWARDS,
S. R. BETTS,
W. A. DUER,
R. H. WALWORTH,
N. WILLIAMS,
SAMUEL NELSON,
E. T. THROOP,
W. B. ROCHESTER.

of the New-York Historical Society, and of the New-York Lyceum of Natural History. Price $2.

The following notices of this work, afford ample testimony of the high character in which it is held.

Extract of a Letter addressed to the author, by the Hon. De Witt Clinton.

Sir.—"I have read your interesting work on the states of Illinois and Missouri with equal pleasure and instruction, and consider it a valuable addition to my library."

From the American Journal of Science and Arts, conducted by Professor Silliman,

"*A Gazetteer of the States of Illinois and Missouri*, 8 vo. pp. 352, by Lewis C. Beck, A. M. has lately been published by C. R. and G. Webster, Albany. Dr. Beck is a member of the New-York Historical Society, and has resided sometime in Missouri. By traversing a considerable portion of these states, by the aid of several intelligent gentlemen in them, by access to the records of the states, and by other means, Dr. B. had accumulated a mass of materials which he has formed into this work, and which make it valuable to the citizens and travellers, and very interesting to *all* who desire information, respecting this important section of our country. The Gazetteer contains 'a general view of each state—a general view of their counties—and a particular description of their towns, villages, rivers, &c. &c.' It is accompanied by a map, 'protracted from manuscript surveys, obtained at St. Louis and Vandalia,' which appears to have been formed with great care. There are also several other engravings, illustrative of the description of particular objects. The 'general view' of each state embraces those particulars which belong naturally to Geography, as well as antiquities, land districts, history, minerals, &c. The botanical names of the principal genera of plants in Missouri, and of the trees of Illinois, are also given, and will be relied on by all who know the success of Dr. B. in the science of Botany. A Gazetteer must of necessity be, to a certain extent, a compilation; but the reader will find abundant proof of Dr. B's diligence, research and originality. The arrangement would perhaps be improved by placing all the towns, &c in both states, in one alphabetical arrangement instead of two. The work is well composed, and neatly printed, and deserves the patronage of the public.—The article, *Military Bounty Tract*, p. 128, and p. 291, contains much very important information to the settlers, and those who propose to move to these states. The articles *Pike County*, *Fort Charlres*, *Fort Dearborn*, *Monk Mound* and *Vandalia*, under Illinois; and *Fenton*, *Noyer Creek*, *St. Louis*, and *Strawberry River*, under Missouri, are particularly interesting."

From the Philadelphia National Gazette, edited by Robert Walsh, Esq.

We have adopted from Professor Silliman's Journal, a short notice of Dr. Beck's "*Gazetteer of the States of Illinois and Missouri.*" This publication came into our hands some weeks ago, and left upon our minds impressions quite as favorable as those expressed

in the notice. When we consider what the countries, now forming the states of Illinois and Missouri were some twenty or thirty years ago, a Gazetteer of them, such as the present, is fitted to inspire a particular interest, and should be regarded as a very common and striking evidence of the progress of American affairs.

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Secret Proceedings and Debates

Of the Convention assembled at Philadelphia, in the year 1787, for the purpose of forming the Constitution of the United States of America—From the Notes taken by the late Robert Yates, Esq. chief justice of New-York, and copied by John Lansing, jr. Esq. late chancellor of that state, members of that convention. Including the "genuine information," laid before the legislature of Maryland, by Luther Martin, Esq. then attorney-general of that state, and a member of the same convention. Also, other historical documents relative to the federal compact of the north American union—and a biographical sketch of the late chief justice Yates. Price $1.50.

New-York State Convention.

Reports of the Proceedings and Debates of the Convention of 1821, assembled for the purpose of amending the Constitution of the State of New-York—Containing all the official Documents, relating to the subject, and other valuable matter. By Nathaniel H. Carter and William L. Stone, reporters, and Marcus T. C. Gould, stenographer. Price $4.

"The volume which is now presented to the public, is the work of different hands; and lays claim to no other merit, than that of being a faithful and impartial record of the proceedings of the convention, which assembled at Albany, on the 28th of August, 1821, and closed its session on the 10th of November following. It consists of the constitution of 1777—the acts of the legislature of March and April, 1821, recommending a convention—a minute and full journal of the proceedings and debates of the convention, arranged in the order in which they occurred, including the reports of the several committees—the ayes and noes on all important questions—and the constitution, as amended—together with an appendix, containing several documents relating to the convention—and a well digested index of the whole volume.

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The American Spelling Book,

Containing the Rudiments of the English Language, for the use of Schools in the United States. By NOAH WEBSTER, Esq. Published by Websters and Skinners, Albany, proprietors of the copy right for the State of New-York.

Extract from Mr. Webster's Address to the Public, March, 1826.

"The elementary book which I published in 1783, then called the Institute and since called Spelling Book, encountered a force of prepossession or prejudice, which few books have encountered with success. It however prevailed—and if we can judge from the numbers sold—not less than *seven millions* of copies—more than half and probably two thirds of all the inhabitants of the United States, have received the rudiments of their education from the use of that book. This is not all—it is the book used in the British colonies on the North and East of the United States, and to some extent, in the West Indies. During the whole period, in which this book has been in use, great and numerous efforts have been made to supersede the use of it, by other books of a like character. I have seen twenty or thirty books of this kind myself; most of them constructed on the same or a similar plan with mine—and some of them nearly copies of it. It has been difficult to form a book, that should have any chance of success, that did not embrace the most essential parts of mine. My tables, especially those of irregular words, the most important of all the classes, are so constructed and so nearly complete, that they cannot be improved. My competitors acknowledge this fact. Hence most of the attempts to supersede the use of this book, have failed—and until within a few years, very little impression has been made on its popularity.

The success which has attended the attempts lately made to rival my book, is to be ascribed to the influence of Walker's pronunciation. Walker was an Englishman, and it is alledged his dictionary is the standard. Under pretence of giving a correct standard, several spelling books have been compiled—three of which are now before me, all from the state of New-York, and I believe from schoolmasters. In order to accomplish their object, it has been found expedient to depreciate my work, and to charge me with *innovation*, and with introducing *a system of orthography and pronunciation, in many respects, vain and pedantic*. Surely, if this is true, if my book is really a bad one, I have been very much deceived, and I have done not only injury, but great and extensive injury to my country. If this is true, I should deeply regret my zeal, and my labors; for I have certainly loved my country, and have cordially devoted myself to its best interests. But I have examined some of the books, which are sent into the world to correct the evil I have done. One of them is little less than a copy of mine—it contains *almost all my tables*, with no alteration except the transposition of a few words. Not less than sixty or seventy pages of it are wholly mine—and what is more, *the pronunciation is mine*, with the exception of a few words.—And this *work is ushered* into the world, under a different name,

and recommended by distinguished characters, who probably did not know that they were recommending *my* book as the work of another man, and a book published in violation of the copy-right law of the United States!

The other books I have seen are somewhat different from mine; but the compilers have borrowed largely from my tables—and what is more remarkable, their pronunciation accords almost wholly with mine.

Now it is to be remarked, that these compilers do not give us Walker's pronunciation, in its full extent—if they did, their books would immediately sink into discredit. As I have been preparing a Dictionary for publication, have, for many years, been teased with the clamor about Walker; I have made a visit to England, and partly with a view to ascertain the real state of the language. I now know, what I before suspected, that no book whatever is considered and received in that country as a standard of orthoepy. There is no standard in England, except that pronunciation which prevails among respectable people, and this though tolerably uniform, is not precisely the same. Walker's scheme does not give this usage—it deviates from it as much as Sheridan's, and even more. There are whole classes of words, whose pronunciation, as marked by Walker, is not warranted by any respectable practice in England. I presume, I can select a thousand words, if not double the number, from Walker's Dictionary, marked for a pronunciation which no man would venture to use, in any decent society in that country. And what is more, I affirm that my own pronunciation, which was introduced into my book long before the name of Walker was known in this country, coincides more nearly with all the good practice which I witnessed in England, than Walker's—not that I agree in all respects with that practice, but the differences are few in number. If the people of this country *will* have an English book to follow, if nothing but *English* will answer, I would recommend Jones' Dictionary, for this purpose. Jones is a later author, who seems to have followed Walker for the express purpose of correcting his errors—and his work, for the simplicity and consistency of his scheme, is far preferable to any other British publication.

I have been an attentive observer of the progress of orthoepy, for fifty years, and am satisfied that from Sheridan's first introduction of his Irish innovations, nearly sixty years ago, all efforts to establish a standard, have only served to *unsettle* the language, and *multiply* diversities.

A gentleman of distinction in the literary world, remarked to me in London, that if a convention of intelligent gentlemen were to meet and consult, for adjusting disputed points, it would be of no use, for no two men would think alike on the subject. *We* learn and *they* learn the language by tradition, and by associating with respectable people—and the force of this common usage cannot be resisted. In this country, it would be as difficult to bring all the people of the different states to agree to any given standard, as it would be to stretch them on the bed of Procrustes and reduce them to the same length. Every schoolmaster wants his own book to be used, and thinks if he can introduce it into

schools, the work is done—So little do these men know their own weakness—and the force of resistance to be overcome.

Do these men suppose that the people of this country will revive the antiquated orthography of such words as *music, publie, rheumatic*, &c. and write them *musick, publick, rheumatick*, because Johnson and Walker wrote them so half a century ago? Do they not know that this orthography has been discarded from the records of parliament, from the records and reports of law proceedings, from Encyclopedias, from periodical publications, from public prints and from the writings of most authors, in Great Britain, for forty or fifty years past? Do they not know, that it has been discarded by congress and the state legislatures, and the courts of law in this country—as well as by all or nearly all American authors? What can these men mean by sending us school-books with this obsolete orthography—an orthography always improper—and now held in disrepute? Even the few adherents to this practice among writers and printers in this country, have been mostly compelled, by the force of usage, to give up the contest. This is a triumph of good sense over pedantry; and a few more such triumphs will leave us our vernacular language in its purity."

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